Industrial emissions policy country profile – Belgium

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Contact:

Tim Scarbrough
Ricardo Energy & Environment
30 Eastbourne Terrace, London, W2 6LA,
United Kingdom

t: +44 (0) 1235 75 3159
e: tim.scarbrough@ricardo.com

Ricardo-AEA Ltd is certificated to ISO9001 and ISO14001

Author:

Marie Dollhofer, Hetty Menadue, Tim Scarbrough

Approved By:

Tim Scarbrough

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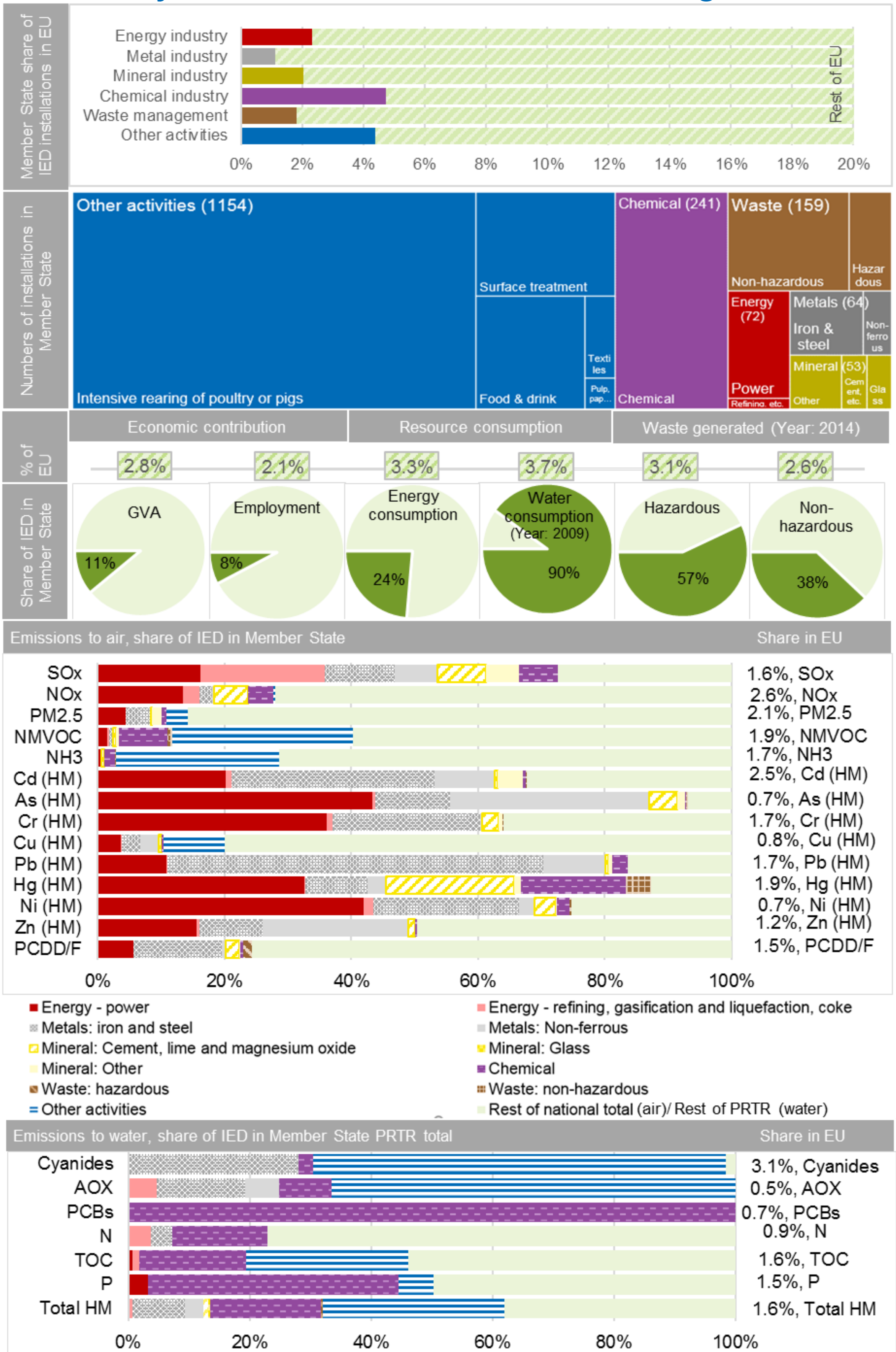
Abbreviations and units

AOX	Adsorbable Organic Halides
As	Arsenic
BE	Belgium
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
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
NMVOC	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 Belgium



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 Belgium.

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 Belgium and how they have been addressed.

The profile also identifies the impact of industrial sectors or activities in Belgium, 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	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.

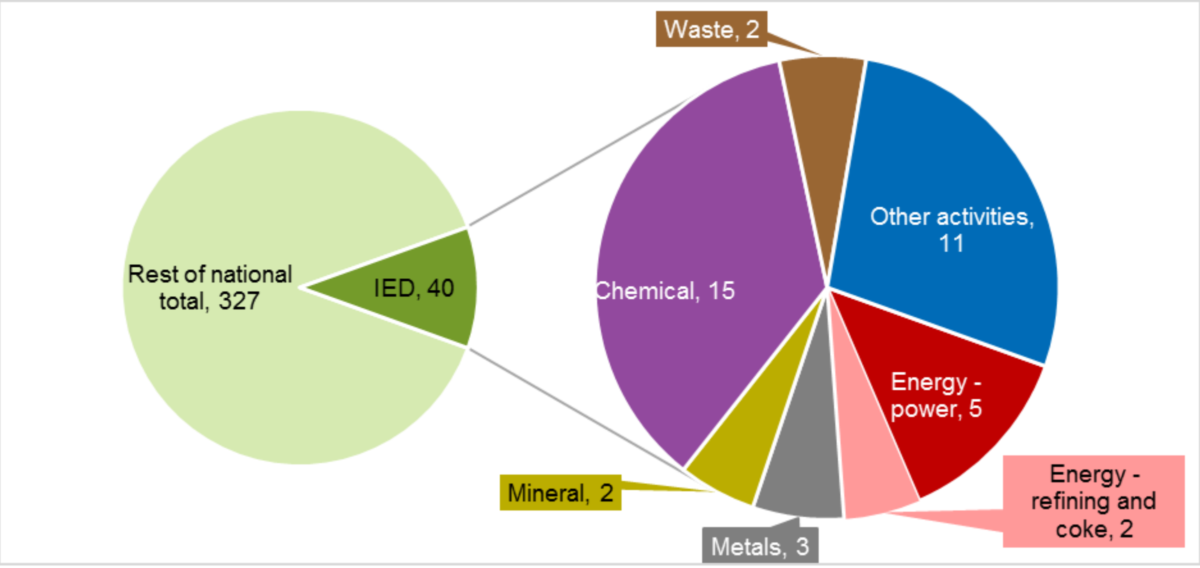
2 Economic significance of industrial sectors

2.1 Economic contribution

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

Industrial sectors comprise a relatively small share of the total GVA across all economic activities in Belgium (12% of total GVA) (illustrated in Figure 1)[1]. Of this share, the chemical sector accounts for the largest contribution. In 2015, the GVA of the Belgian chemical sector amounts to 15 billion EUR representing 37.5% of the industrial sectors. The second largest industrial sector contributing to GVA in Belgium is 'other activities', amounting to 11 billion EUR (3.4% of total GVA). This share mainly derives from the food, drinks and tobacco sector (2% of total GVA), and the textiles (0.4% of total GVA), wearing apparel, and leather sector.

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



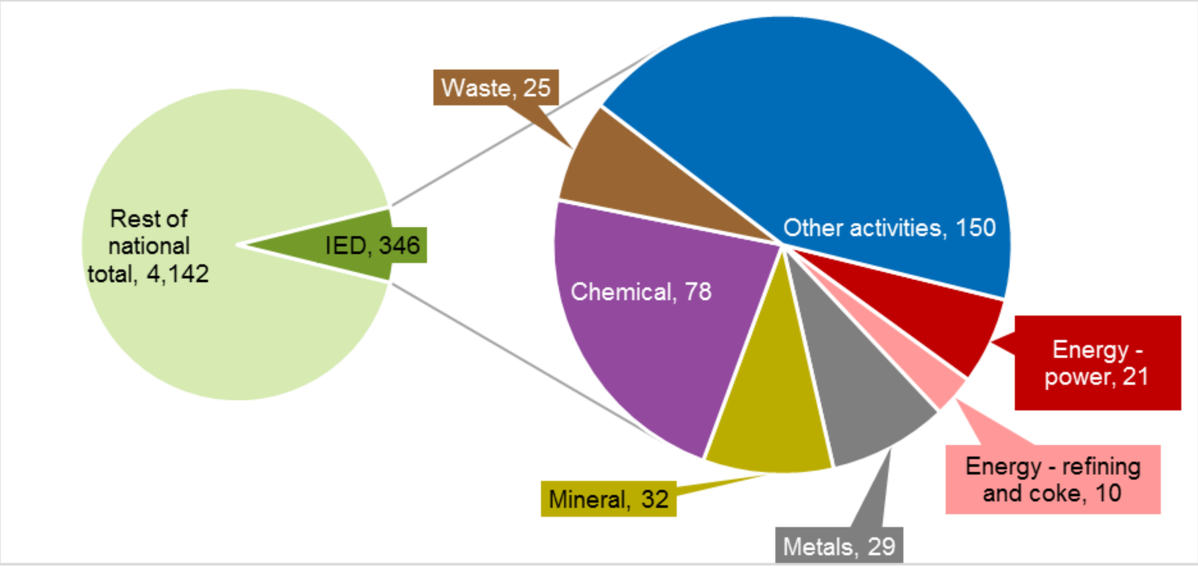
Note: Rest of national total means all NACE activity minus the industrial sectors shown here. No GVA data was available for the year 2015 for the waste, metals and minerals sectors and the manufacture of pulp, paper and wood products within 'other activities', therefore, extrapolations have been carried out based on data reported for 2012 - 2014. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the GVA cannot be excluded for this activity.

Source: Eurostat (2017a)

In 2015, the relative share for employment by industrial sector shows a slightly different picture compared to GVA (Figure 2). The share of employees is greater under 'other activities' (3.6% of total employment in Belgium) compared to chemicals (1.9% of total employment in Belgium).

[1] Energy – refining and coke is grouped in these profiles with gasification and liquefaction; however, as no permitted installations were reported for these IED activities, the sector is referred to as energy - refining and coke in the Belgium profile.

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



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

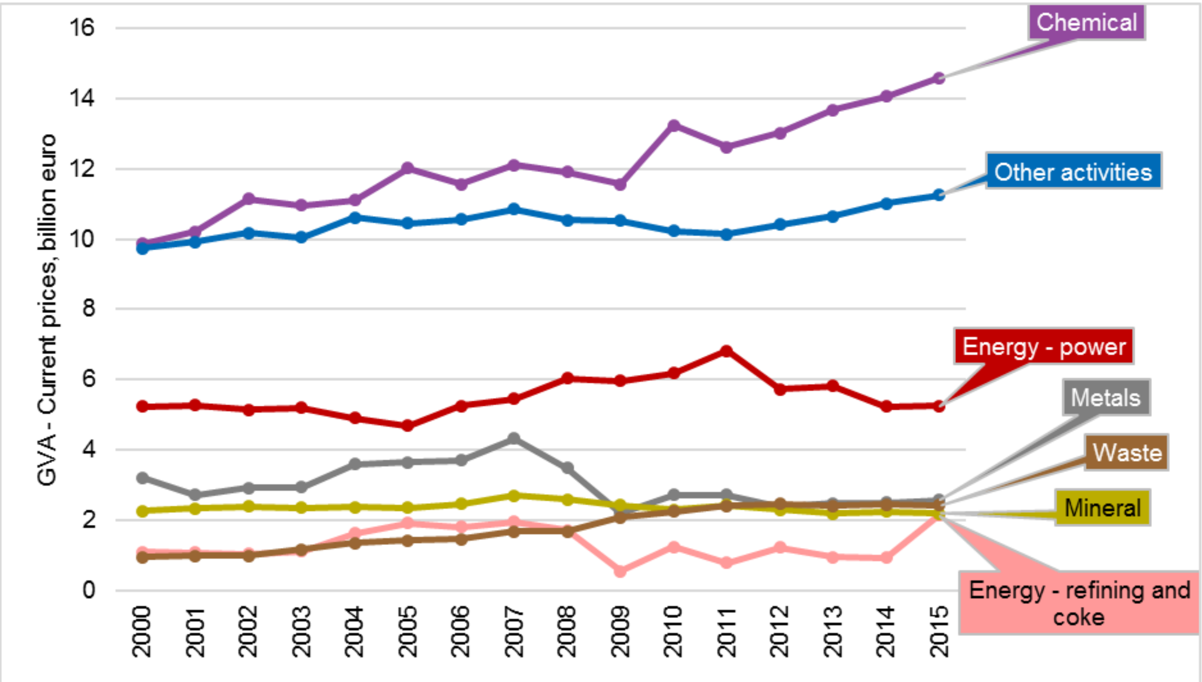
Source: Eurostat (2017b)

Since 2000, the main areas of economic growth in Belgium, as measured by growth in GVA, are the chemicals sector, 'other activities' and the waste management sector (Figure 3). The largest industrial sector contributing to GVA, the chemical sector, has grown from ~€10 billion in 2000 to ~€14.5 billion in 2015, albeit with some fluctuations over this period; the sector has grown continuously since 2011. The GVA of 'other activities' has similarly grown continuously since 2011; during the 2000s the GVA of 'other activities' both grew and shrank. Although small, the GVA of the waste industry has grown from ~€1 billion in 2000 to an estimated €2.5 billion in 2015.

The GVA of the other industrial sectors in Belgium fluctuated and did not grow over the period 2000 to 2015. The metals sector experienced growth in GVA from ~€3 billion in 2000 until 2007 and declined back to €3 billion in 2015.

Despite growth in GVA, employment in the chemical sector has decreased since 2008. Although the chemical sector has the highest GVA the 'other activities' sector provides the highest employment in Belgium in 2015 with ~150,000 employees, which is nearly twice as much compared to ~80,000 in the chemical sector (Figure 4). However, since 2008, the GVA growth for the industrial sector 'other activities' is also accompanied by a decline in the number of employees in the sector.

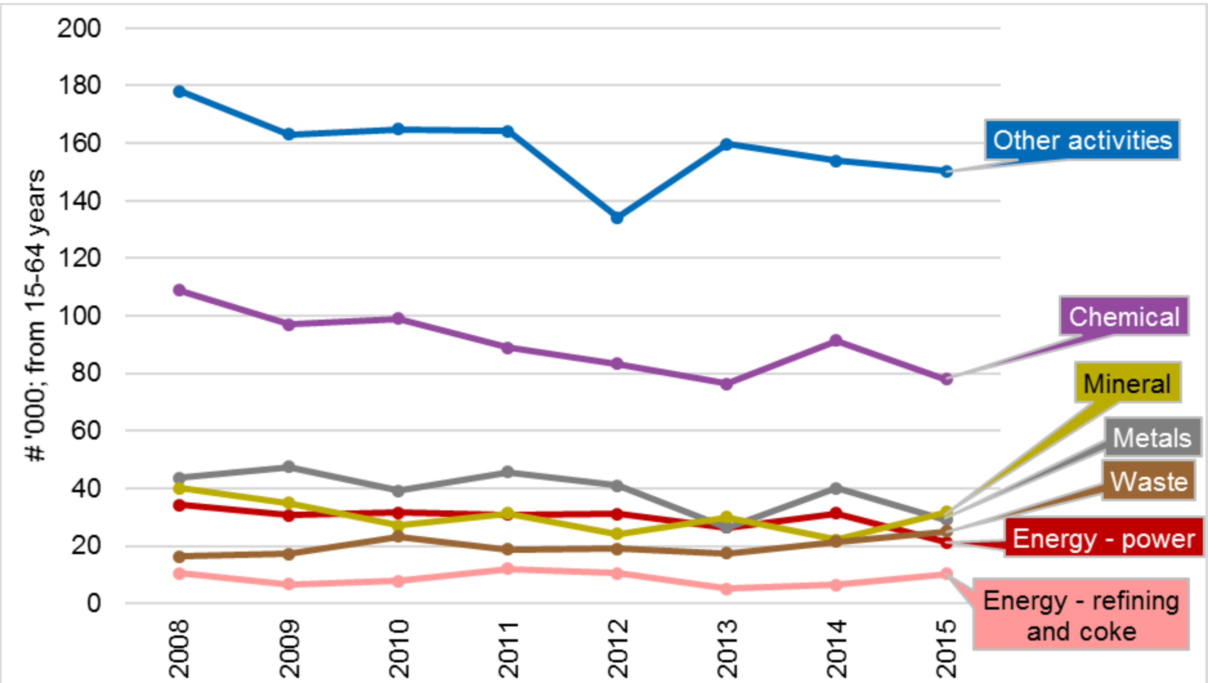
Figure 3: Gross value added of industrial sectors (2000-2015)



No GVA data was available for the year 2015 for the waste, metals and minerals sectors and the manufacture of pulp, paper and wood products within 'other activities', therefore, extrapolations have been carried out based on data reported for 2012 - 2014. The data shown for 'other activities' includes, among others, the sub sectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installation s are permitted for tanning, the GVA cannot be excluded for this activity.

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 Belgium

Missing data	Description	Conclusion and actions taken
Data gaps	2015 GVA is not reported for several sectors. Complete dataset for previous years so extrapolation undertaken to fill the gap	Extrapolation undertaken
No IED installations reported for tanning [of leather] IED activity	The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.	No action

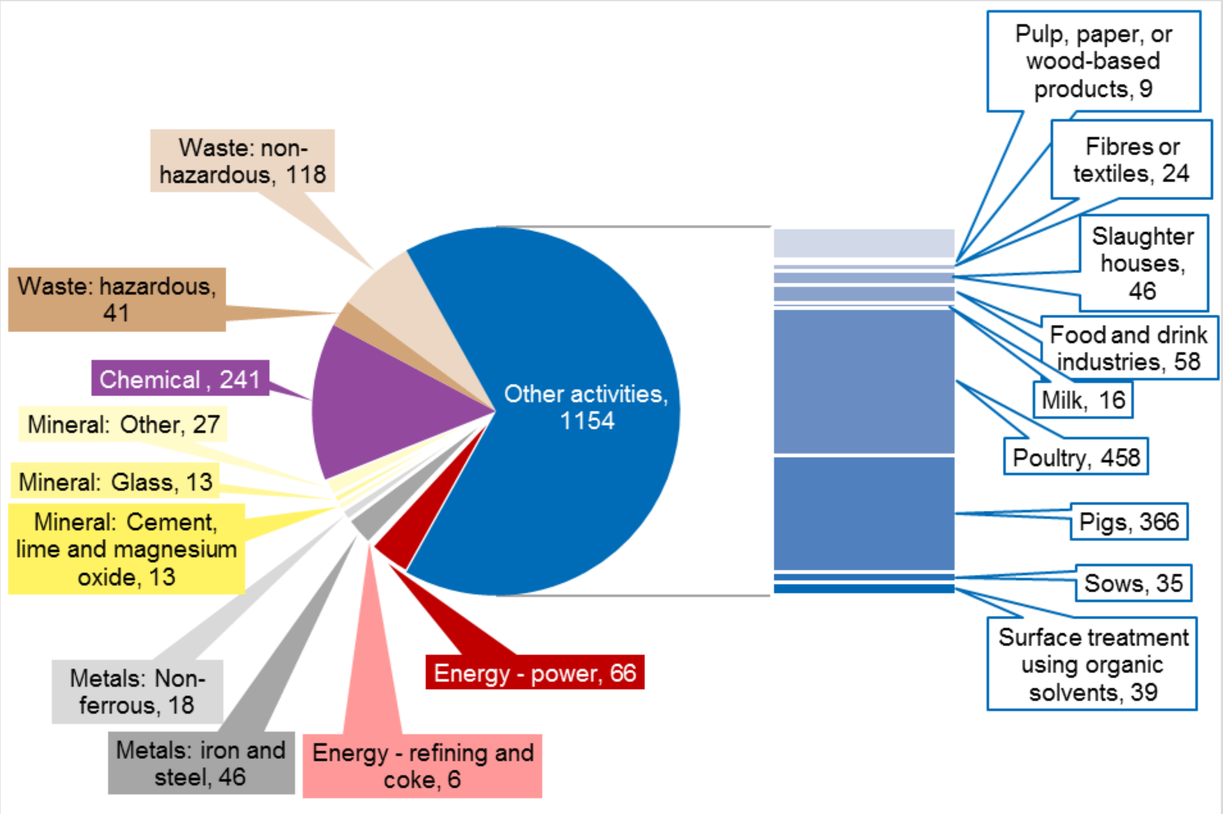
No national data gaps identified for the employment data.

2.2 Number of IED installations

Belgium has a reported total of 1,743 IED installations. The main industrial sector in 2015, according to the reported number of IED installations, is 'other activities' and more precisely the intensive rearing of poultry and pigs (49% of total IED installations) (Figure 5, Table 3). This is followed by the chemical industrial sector (14% of total IED installations), the non-hazardous waste management industrial sector (7% of total IED installations) and the energy - power industrial sector (4% of total IED installations).

Permits are reported for all IED activities except tanning (IED activity 6.3) and production of carbon (IED activity 6.8) within 'other activities'.

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 2015 by industrial sector, with IED activity detail

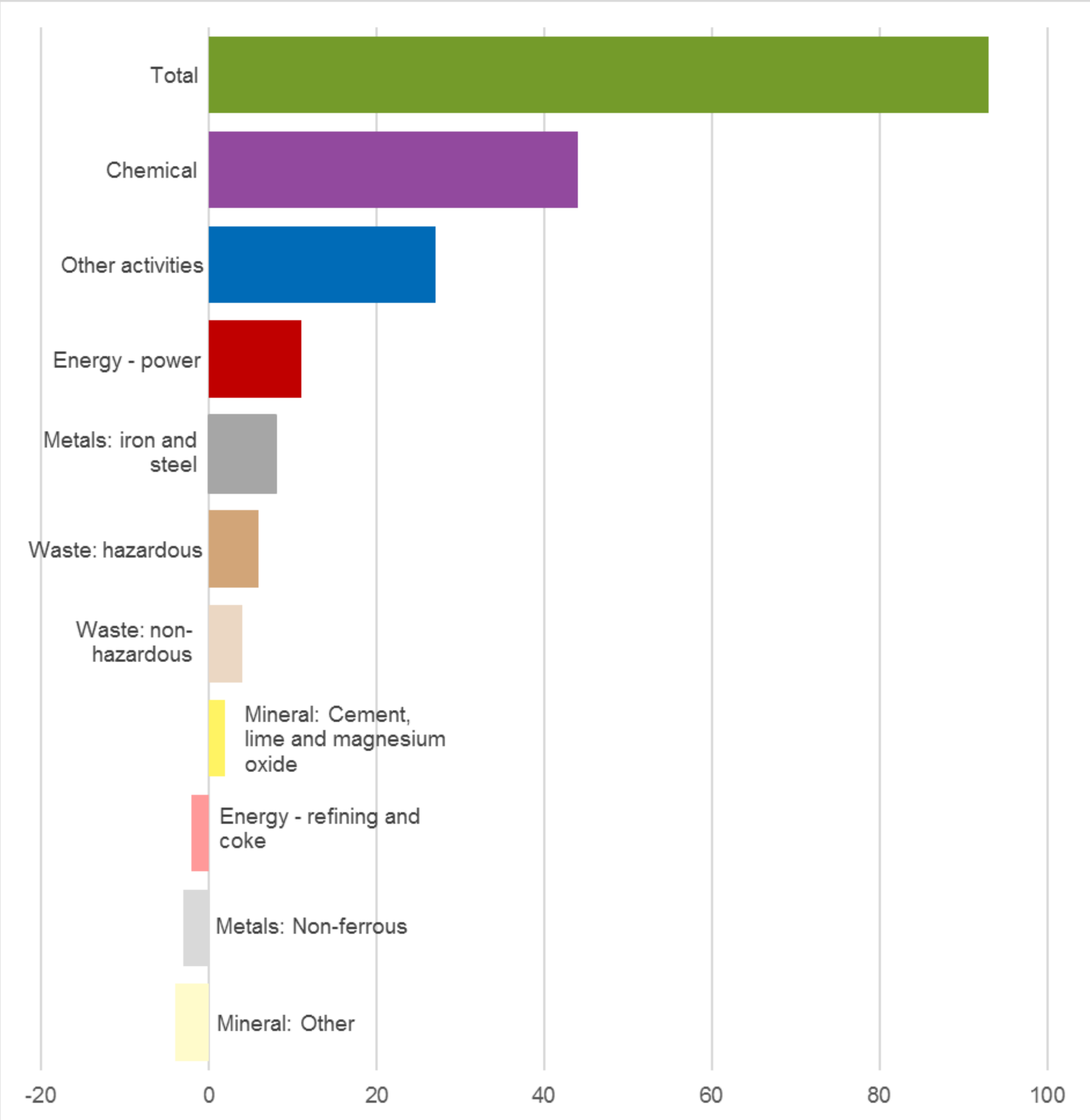
Industrial sector, with IED activity detail	2011	2015	Change in number of IED installations 2011 to 2015
Energy: power *1.1 Combustion*	**55**	**66**	**11**
Energy: refining and coke	**8**	**6**	**-2**
1.2 Refining	*7*	*4*	*-3*
1.3 Production of coke	*1*	*2*	*1*
Metals: iron and steel	**38**	**46**	**8**
2.1 Metal ore	*1*	*2*	*1*
2.2 Pig iron or steel	*12*	*12*	*0*
2.3 Processing of ferrous metals	*15*	*20*	*5*
2.4 Ferrous metals foundries	*10*	*12*	*2*
Metal: non-ferrous *2.5(a) Processing of non-ferrous metals*	**21**	**18**	**-3**
Mineral: Cement, lime and magnesium oxide *3.1 Cement, lime and magnesium oxide*	**11**	**13**	**2**
Mineral: Glass *3.3 Glass*	**13**	**13**	**0**
Mineral: Other	**31**	**27**	**-4**
3.4 Mineral fibres	*0*	*1*	*1*
3.5 Ceramic	*31*	*26*	*-5*
Chemical	**197**	**241**	**44**
4.1 Organic chemicals	*134*	*167*	*33*
4.2 Inorganic chemicals	*35*	*45*	*10*
4.3 Phosphorus-, nitrogen- or potassium-based fertilisers	*10*	*7*	*-3*
4.4 Plant protection products	*5*	*6*	*1*
4.5 Pharmaceutical products	*12*	*15*	*3*
4.6 Explosives	*1*	*1*	*0*
Waste: hazardous *5.1 Disposal / recovery*	**35**	**41**	**6**
Waste: non-hazardous	**114**	**118**	**4**
5.2 co-/ incineration of hazardous and non-hazardous waste	*19*	*19*	*0*
5.3 Disposal of non-hazardous	*58*	*59*	*1*
5.4 Landfills	*32*	*32*	*0*
6.5 Disposal of animal carcases	*5*	*8*	*3*
Other activities	**1127**	**1154**	**27**
6.1 Pulp, paper, or wood-based products	*8*	*9*	*1*
6.2 Textiles	*25*	*24*	*-1*
6.7 Surface treatment using organic solvents	*38*	*39*	*1*
2.6 Surface treatment of metals and plastic	*113*	*103*	*-10*
6.4 (a) Slaughterhouses	*48*	*46*	*-2*
6.4 (b) Food and drink	*42*	*58*	*16*
6.4 (c) Milk	*16*	*16*	*0*
6.6 (a) Poultry	*447*	*458*	*11*
6.6 (b) Pigs	*361*	*366*	*5*
6.6 (c) Sows	*29*	*35*	*6*
Total	**1650**	**1743**	**+93**

Note: IED activities are in italics. No installations for gasification or liquefaction. 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 an increase in the reported number of IED installations permitted in Belgium (comparing IPPCD installations to IED installations in this timeframe) (Figure 6). This increase is largely the increases in the chemical sector (from 197 installations in 2011 to 241 in 2015), as well as 20% more installations in the energy - power sector and 18% more installations in the cement lime and magnesium sector. There has also been a small decrease in the number of permitted IED installations in the energy - refining and coke ovens sector, the non-ferrous metal industry, and the mineral-other (ceramics) sector between 2011 and 2015.

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



Note: No change reported for the mineral glass sector and so 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.

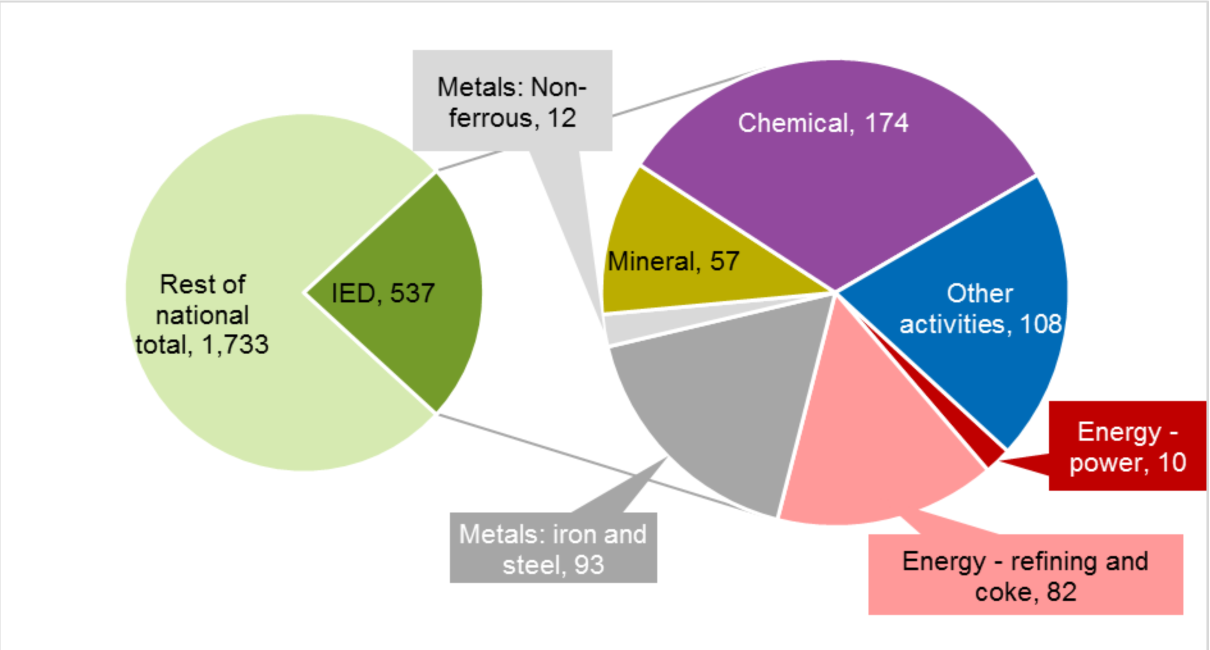
3 Resource use in industrial sectors

3.1 Energy consumption

In 2015 Belgium's industrial sectors accounted for 24% of the total energy consumption in Belgium. Among the industrial sectors, the chemical sector consumed the most energy in 2015, accounting for one third of the industrial sector energy consumption followed by 'other activities (20%) and the iron and steel sector (17%) (Figure 7). The energy consumed by industries within the industrial sector of 'other activities' can mostly be attributed to the food and drink and the paper, pulp and wood-based product sectors. The iron and steel as well as the energy - refining and coke industries consume high levels of energy, 4.1% and 3.6% of total Belgian energy consumption respectively, across relatively few IED installations: 46 iron and steel installations and 6 energy - refining and coke installations. In comparison, the 'other activities' have a lower energy use (4.8%) for 1,154 installations.

Note that no data was reported for the waste management sector (explained in Table 4). However, the Eurostat energy consumption dataset has limited coverage of the waste management sector. This is a significant gap for Belgium in the data in light of the large number of installations within this industrial sector permitted in Belgium (159 IED installations), as well as the waste generated by the sector (see section 5).

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

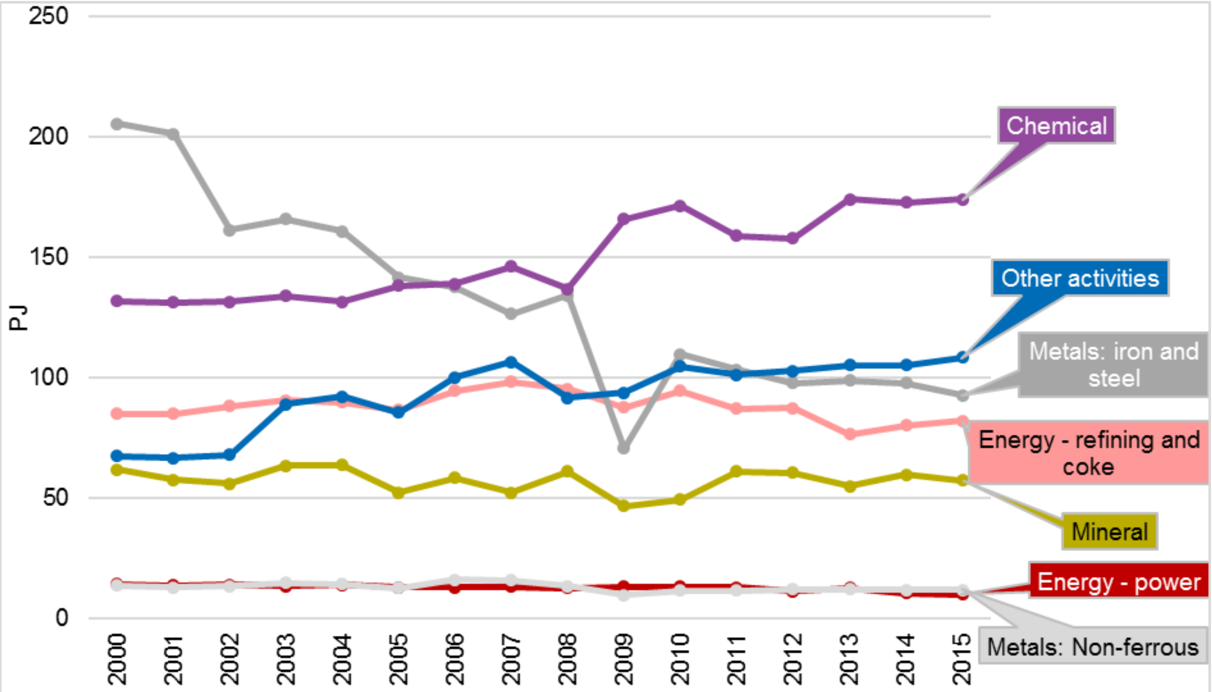


Note: Rest of national total relates to gross inland consumption minus the industrial sectors shown here. No data for the waste management sector. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.

Source: Eurostat (2017c)

The time series in Figure 8 shows that energy consumption of most industrial sectors has increased or remaining broadly level between 2000 and 2015. The sole exception is the iron and steel sector whose energy consumption approximately halved from ~200 PJ in 2000 to slightly below 100 PJ in 2015. However, this is the only sector where this occurred in Belgium. The sectors with increased energy consumption over the period 2000 to 2015 are the chemicals and sector and 'other activities'. The chemical sector increased energy consumption from ~130 PJ in 2000 to ~170 PJ in 2015. The 'other activities' almost doubled their energy consumption from 2000 to 2015. This can be explained for both sectors by their growth in GVA over the period and more recently growth in number of permitted installations. To explain the decrease in the iron and steel sector energy consumption however, there is no such similar important decrease in IED installations for the iron and steel sector, on the contrary the number of installations increased by 13% from 2011 to 2015. The decreasing energy consumption may therefore relate to a change in production process(es) and / or improvements in energy efficiency in the past years.

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



Note: No data were available for the waste management sector. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.

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 for the waste management sector has only limited coverage of this 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, this is rather a limitation that the energy consumption dataset has poor representation of the waste management sector.

Table 4: Gaps in energy consumption data for Belgium

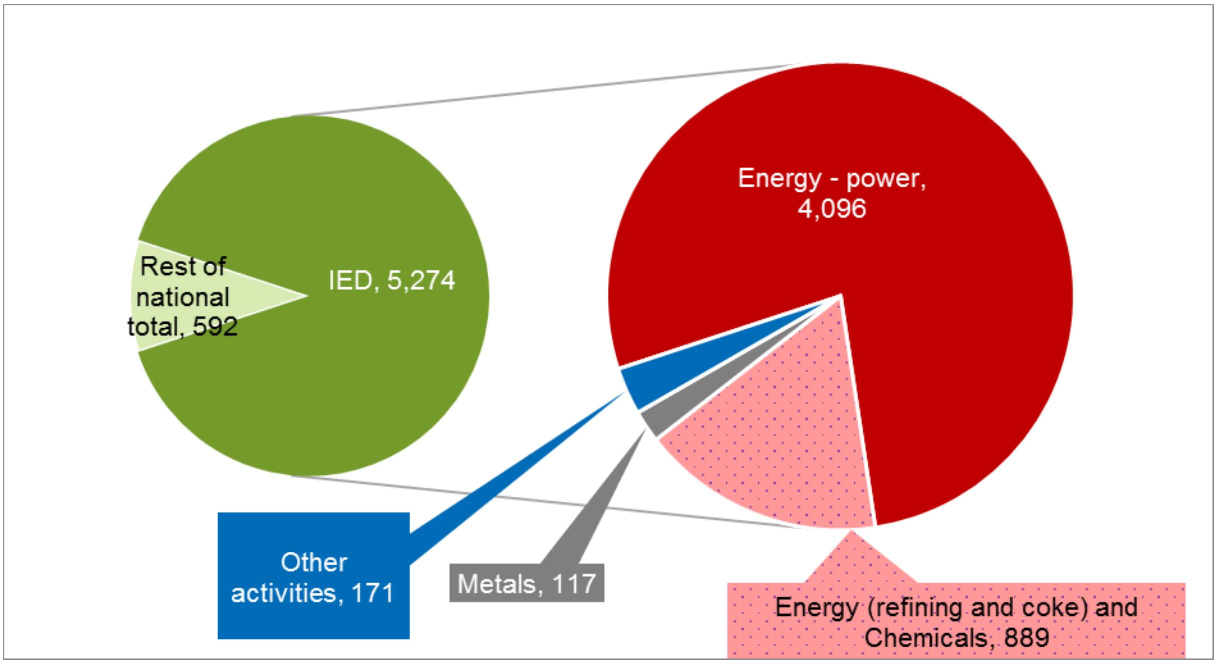
Missing data	Description	Conclusion and actions
No IED installations reported for gasification and liquefaction	Separate energy balance indicators are reported for this IED activity within the energy – refining and coke sector.	Respective energy balance indicators removed from energy consumption for energy - refining, etc. to avoid over reporting.
No IED installations reported for tanning [of leather] IED activity	The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.	No action
Data gap	No data reported for the only energy indicator for non-hazardous waste management sectors (B_101318 – Consumption in Gasification plants for biogas)	No action

3.2 Water consumption

The availability of data showing water consumption by industrial sector in Belgium is poor. Only limited data is available in Eurostat (2017d) in terms of years and coverage of sectors (with the latest data reported for 2009).

Data showing consumption by industrial sector for 2009 is only available for a limited number of sectors (Figure 9). According to the data available the energy - power sector consumed 4,096 million m³ water, which is by far the largest share reported. However, the reliability of data is to be questioned as it suggests that IED industrial sectors were responsible for ~90% of total water consumption in Belgium.

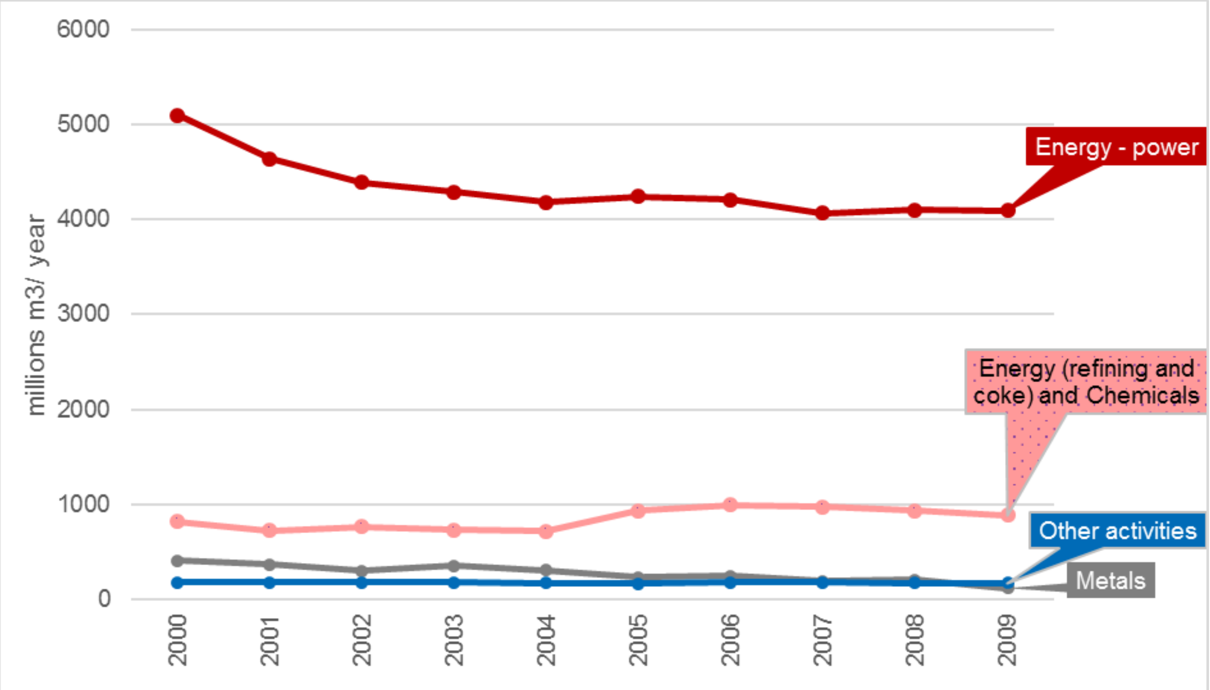
Figure 9: Water consumption (million m³) for selected industrial sectors (2009)



Note: No data reported for the waste management sector. No data available for the mineral sector by itself. The data shown for 'other activities' includes, among others, the sub sectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.

Source: Eurostat (2017d)

Figure 10: Water consumption (million m^3) for selected industrial sectors (2000-2009)



Note: No data reported for the waste management sector. No data is available for the mineral sector by itself. No data reported for more recent years than 2009 for all sectors. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.

Sources: Eurostat (2017d)

Limitations

Limitations have arisen from the mapping owing to combined reporting of NACE classifications for energy (refining, coke) and chemicals. 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.

Table 5: Data gaps in water consumption data for 2009

Missing data	Description	Conclusion and actions taken
Limited time series	Data reported to Eurostat (2017d) is only available until 2009 and not reported by all sectors.	No action
No IED installations reported for tanning [of leather] IED activity	The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.	No action

4 Emissions from industrial sectors

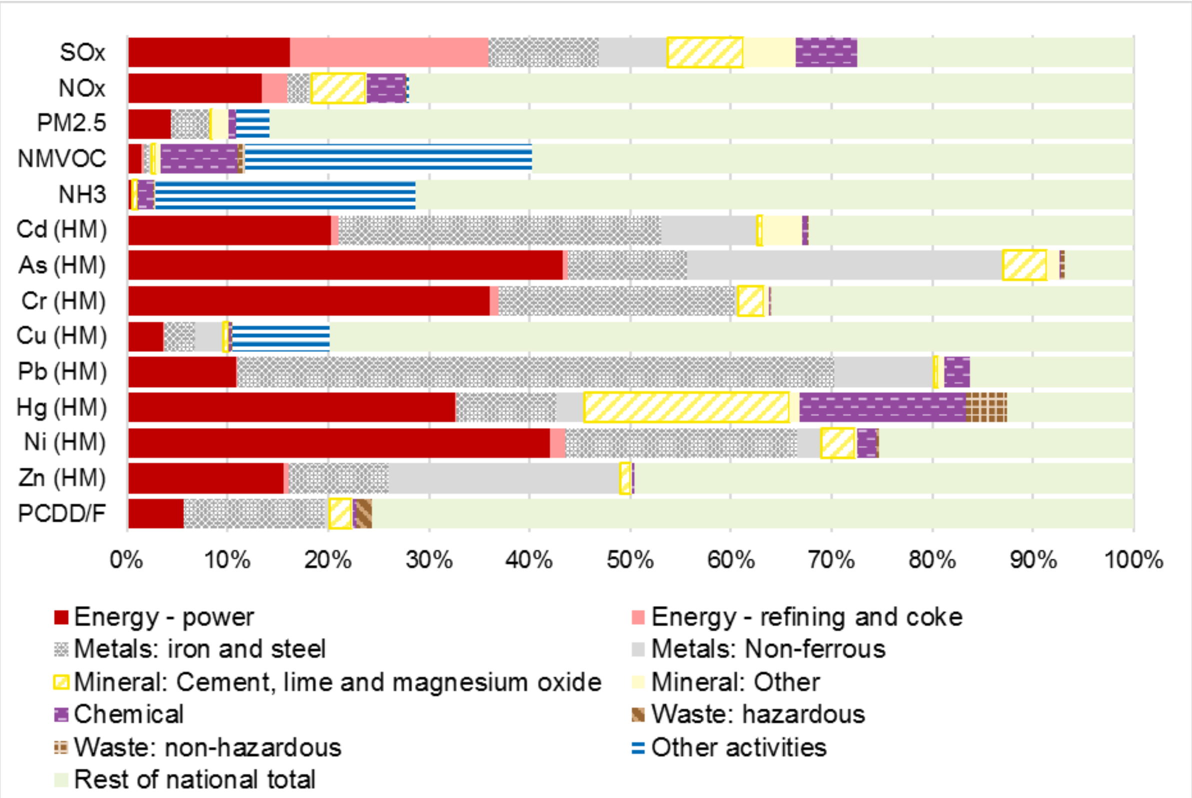
4.1 Emissions to air

Data were taken from inventories submitted by Member States under the CLRTAP (EEA, 2017a). Overall in 2015, industrial sectors are responsible for most of the SO_X, Cd, As, Cr, Pb, Hg, Ni, and Zn emissions to air (Figure 11). The industrial sectors emit the majority of most heavy metals and SO_X compared to the rest of the national total (with over 50% of aforementioned emissions emanating from industrial sectors).

The energy-power and metals industrial sectors are a key source of emissions to air for SO_X, Cd, As, Cr, Pb, Hg, Ni, Zn (Figure 12). The energy-refining and coke sector contributes a substantial fraction of total SO_X emissions. The chemicals and cement, lime and magnesium oxide production sectors contribute significant proportions of total SO_X and Hg emissions. The 'other activities' industrial sector contributes significantly to the industrial emissions of NMVOCs, NH_3, Cu, and $PM_{2.5}$. The main sources of NMVOC and $PM_{2.5}$ emissions to air within 'other activities' are intensive rearing of poultry or pigs, the food and drink industry, and surface treatment. The main source of NH_3 emissions is manure management (NFR sector 3B3, 3B4gi-ii) from intensive rearing of poultry or pigs. Surface treatment activities is also the sole emitter of Cu within 'other activities' which is by far the highest share emitted compared to other sectors' emissions of Cu.

Although 13 IED installations are reported in the mineral-glass sector, no emissions to air data were reported for this sub-sector in 2015.

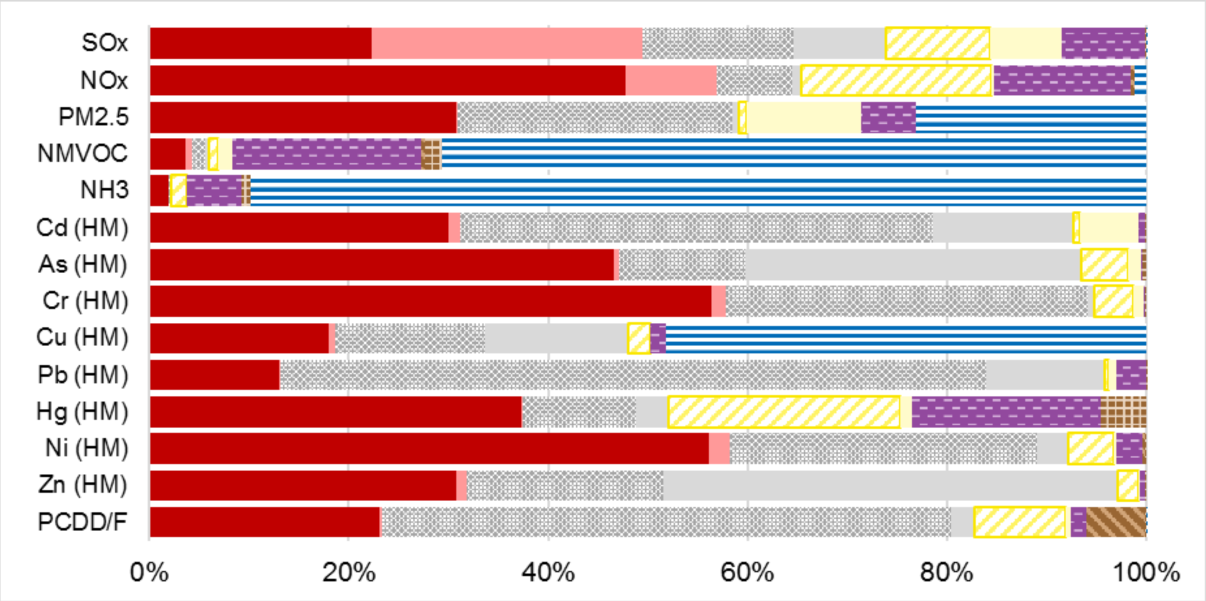
Figure 11: Emissions to air from industrial sectors and rest of national total (2015)



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 emissions to air were reported for glass in 2015.

Source: EEA (2017a)

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



Note: The key for this chart is shown in Figure 11. No emissions to air were reported for glass.

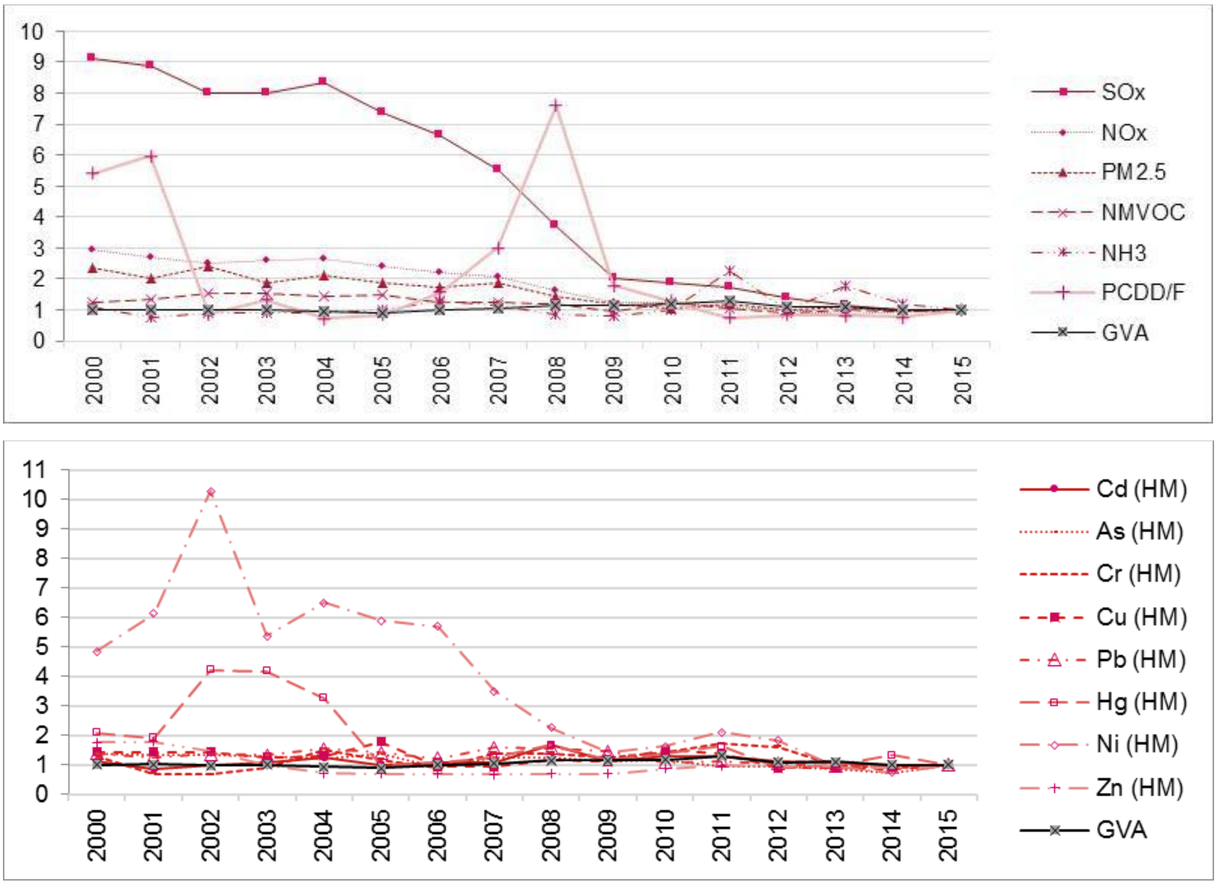
Source: EEA (2017a)

In the following subsections, emissions data 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.

Energy industry

For the energy - power sector, the general trend is a significant decrease of emissions from 2000 to 2015 for many pollutants (Figure 13), particularly for SO_X, NO_X, $PM_{2.5}$, Ni and to a lesser extent for Hg. These reductions do not appear to be coupled to the energy - power sector GVA which has remained fairly static over this period. The reduction of air emissions may therefore be related to tighter controls on these pollutants driven by legislation. The PCDD/F emissions have varied substantially over the period with high peaks in the early and late 2000s. The significant emission reduction in the early 2000s is probably due to the installation of filters in the waste incineration facilities; the peak in 2008 could result from incineration of sludge (GoF 2008). it is unclear what has led to these significant variations. Emissions of most of the remaining heavy metals have decreased slightly over the period from 2000 to 2015.

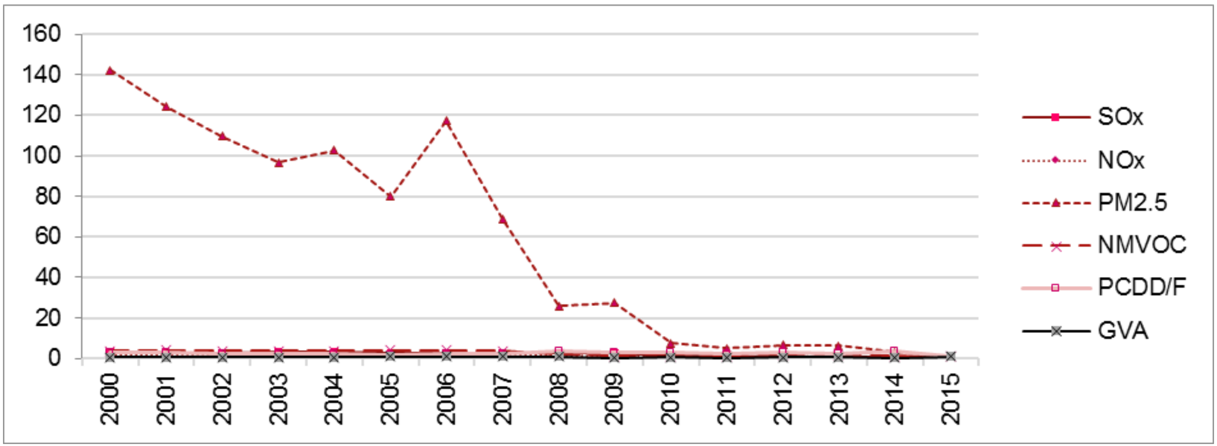
Figure 13: Indexed emissions to air from the energy - power industrial sector (indexed to 2015=1)

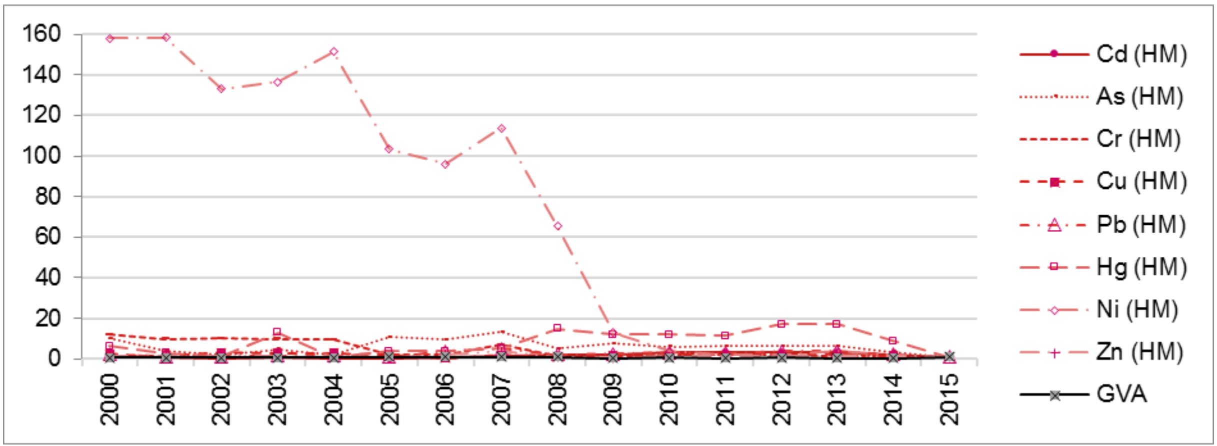


Source: EEA (2017a), Eurostat (2017a)

Within the energy - refining and coke sector air emissions do not appear to be coupled to this sector's GVA as emissions keep decreasing between 2003 and 2009 despite GVA increases. The most significant decline in air emissions is reported for $PM_{2.5}$ and Ni (Figure 14). SO_X, NMVOC, NO_X, and PCDD/F all show reductions over the period 2000 to 2015 (Figure 15), despite a growth in this sector's GVA. This industry has lowered its emissions especially since 2013 for all heavy metals, against the backdrop of increasing GVA. However, significant fluctuations are reported between 2000 and 2008. This detail is made visible in Figure 15.

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

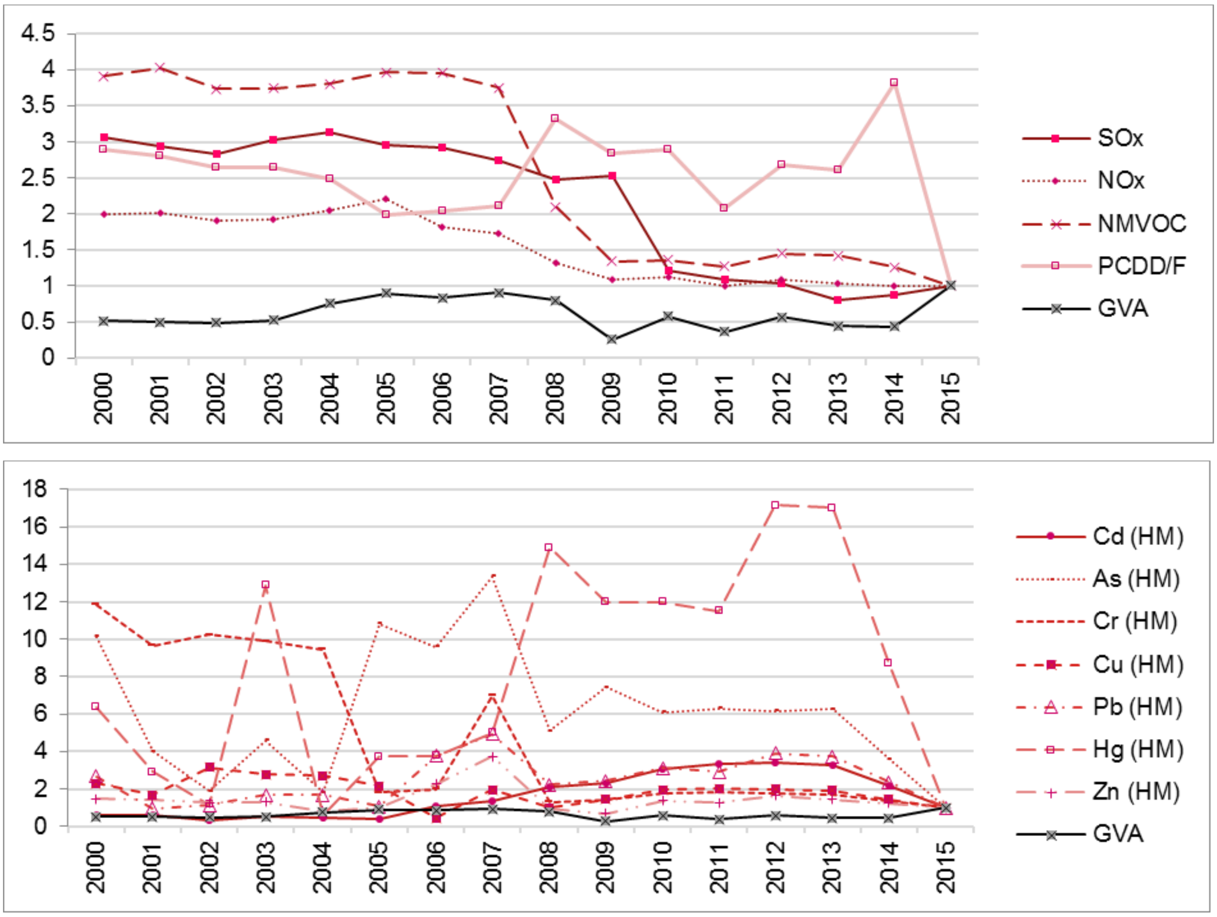




Note: NH_3 is not shown as it is reported as zero in 2015 for the sector.

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

Figure 15: Indexed emissions to air from the energy - refining and coke sector with outliers removed (indexed to 2015=1)



Note: $PM_{2.5}$ and Ni removed in the charts above to make the detail visible for the other pollutants. NH_3 is not shown as it is reported as zero in 2015 for the sector

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

Metal industry

The trends for emissions from the iron and steel sector are shown in Figure 16. The largest proportional emission decreases since 2000 are for the pollutants PCDD/F, $PM_{2.5}$ and, among the heavy metals, Zn and Cr. All the heavy metals in fact show decreases over the period 2000 to 2015 compared to the GVA trend which remains rather constant.

Figure 16: Indexed emissions to air from the iron and steel sector (indexed to 2015=1)

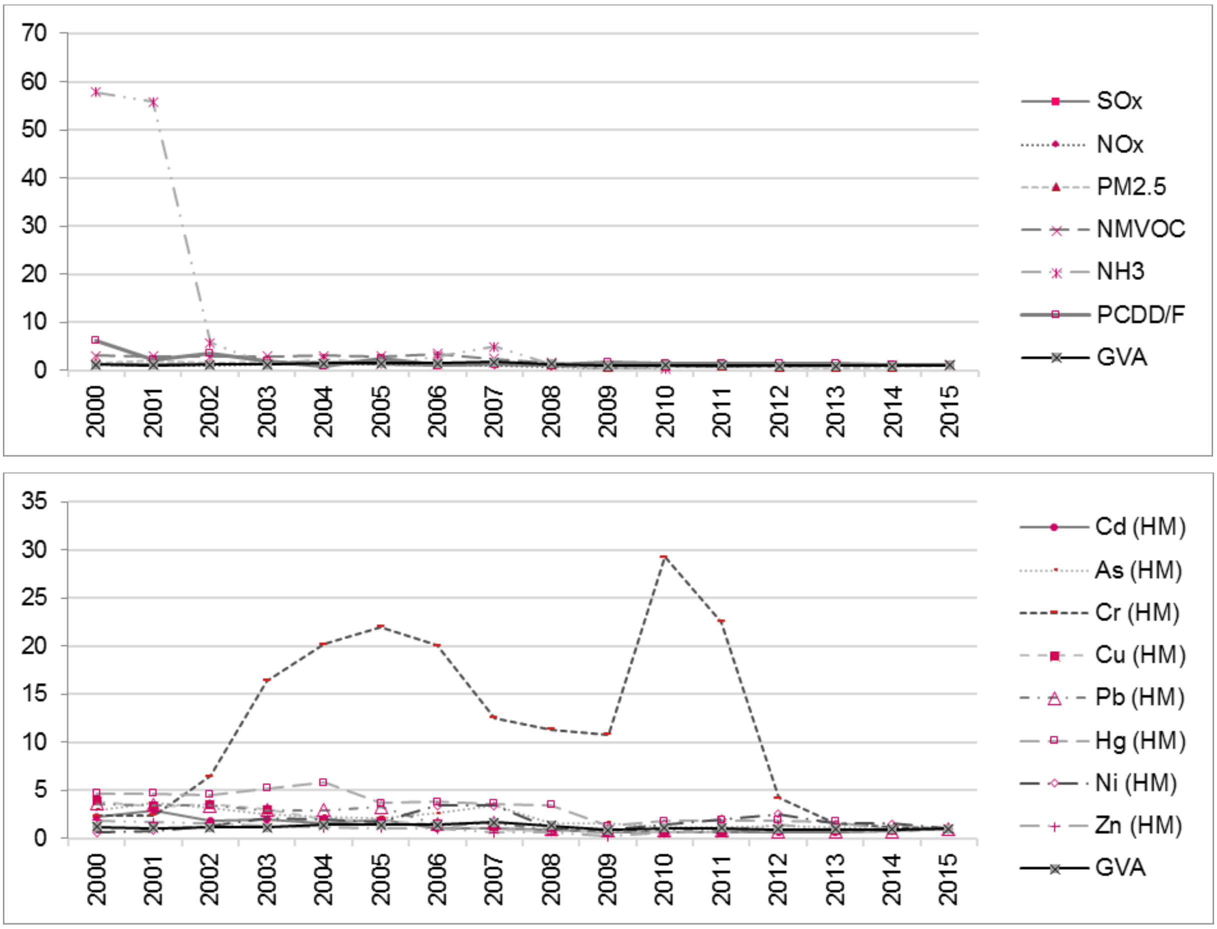
Source: EEA (2017a), Eurostat (2017a)

Emissions reported for the non-ferrous metals sector are shown in Figure 17 and Figure 18 with outliers removed. The most significant contributions of this sector to national total emissions in 2015 are for Zn, As, Cd, Cu, Pb and SOx.

Emissions of NH_3 from the production of non-ferrous metals reduced significantly between 2000 and 2002 and peaked again in 2007 although to a much lesser extent compared to pre-2002 levels. Emissions of Cr increased significantly between 2001 and 2013, after which they have decreased. It is unclear what has driven this trend. For both NH_3 and Cr, the trend lines are more exaggerated compared to the other pollutants presented in the charts; as such both pollutants are removed from Figure 18 in order to make the trend lines more visible for the other pollutants.

Generally, all pollutants have decreased over time. However, Figure 18 shows that emissions of $PM_{2.5}$ have fluctuated over the time series: increasing between 2000 and 2004, and again from 2009 until 2014; and decreasing in between these years.

Figure 17: Indexed emissions to air from non-ferrous metal production (metal industrial sector) (indexed to 2015=1)



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

Figure 18: Indexed emissions to air from non-ferrous metal production (metal industrial sector) (indexed to 2015=1), with outliers removed (NH_3 and Cr)

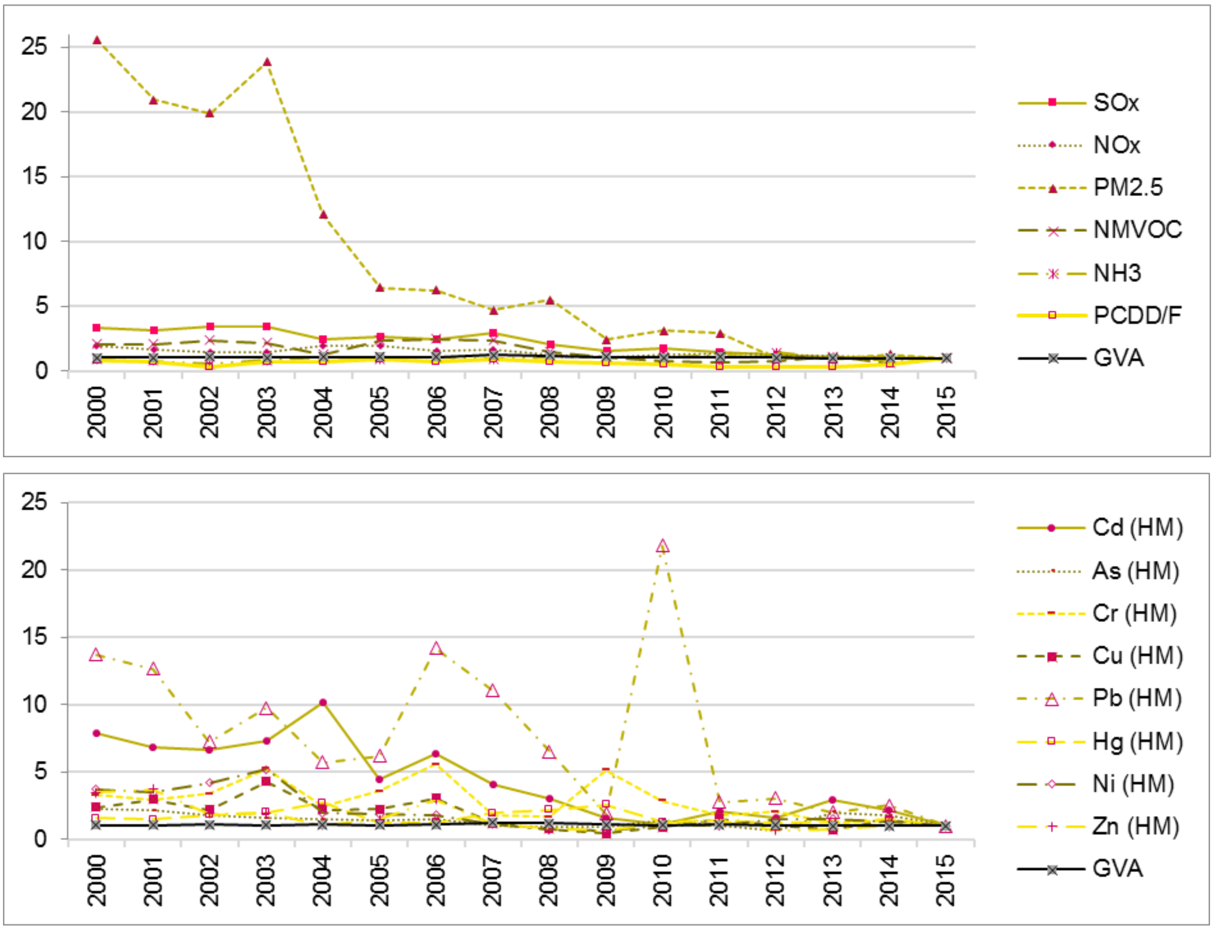
Source: EEA (2017a), Eurostat (2017a)

Mineral industry

In the cement, lime and magnesium oxide production sector the number of installations permitted has increased in the Walloon region since 2011, and the sector GVA has been relatively constant from 2000 to 2015. Emissions of most air pollutants in general however follow a downward trend over this fifteen-year period. Emissions of Pb have decreased by a factor of almost 14 since 2000 although with a peak in 2010, whilst emissions of $PM_{2.5}$ are reported to have decreased by a factor of 25 over this same period (Figure 19). NO_X and NMVOC emissions from this sector approximately halved since 2000, whilst emissions of NH_3 and PCDD/F have increased slightly, albeit with some fluctuations. All the heavy metal emissions have reduced since 2000, although the lowest emission levels were recorded in 2009 during the economic crisis and may be correlated with lower activity levels. See Figure 20 for the detail.

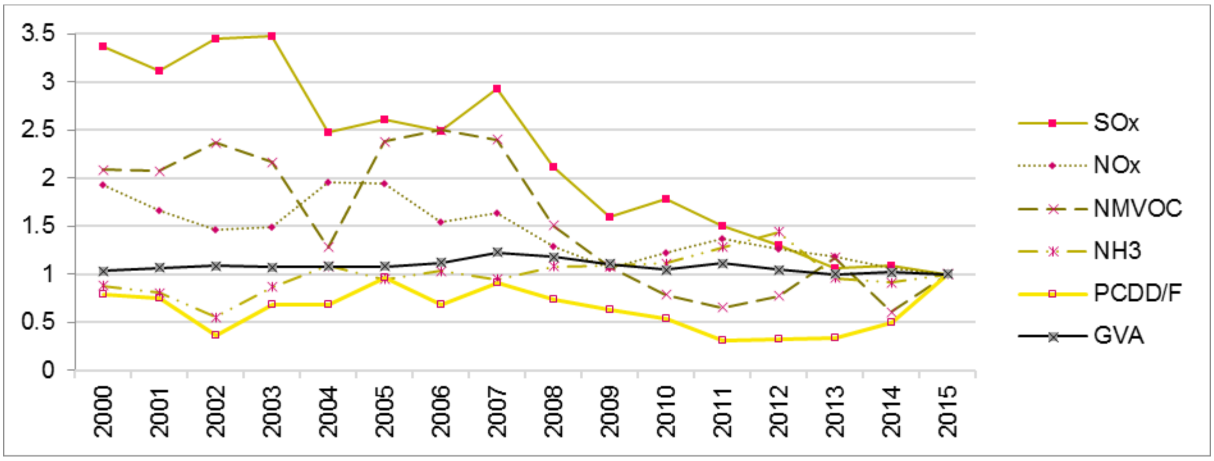
No emissions to air are reported for the glass industry across all the years despite having 13 IED installations reported in 2015. The LRTAP inventory reports emissions from this sector as being “included elsewhere”.

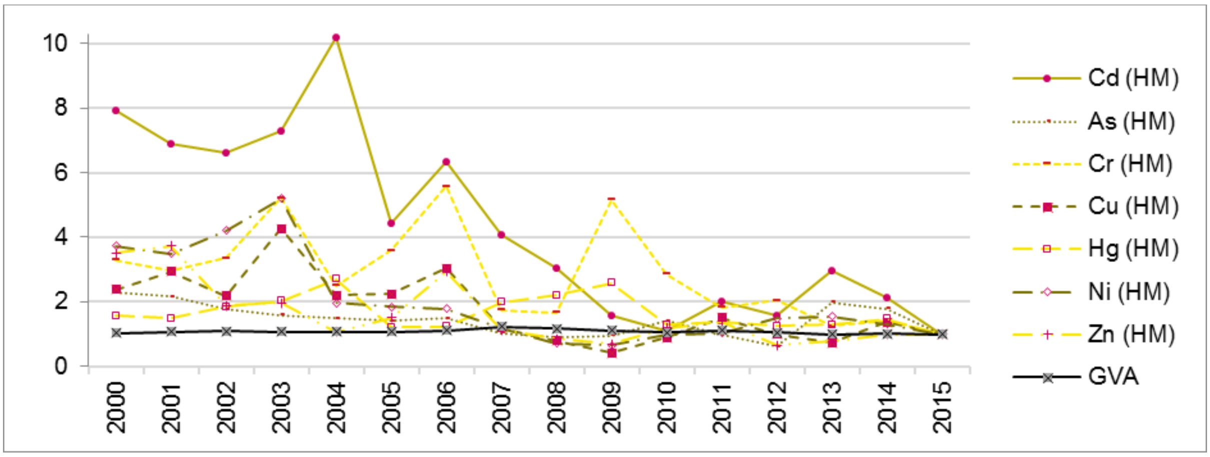
Figure 19: Indexed emissions to air from cement, lime and magnesium oxide production (indexed to 2015=1)



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

Figure 20: Indexed emissions to air from cement, lime and magnesium oxide production (indexed to 2015=1) with outliers removed



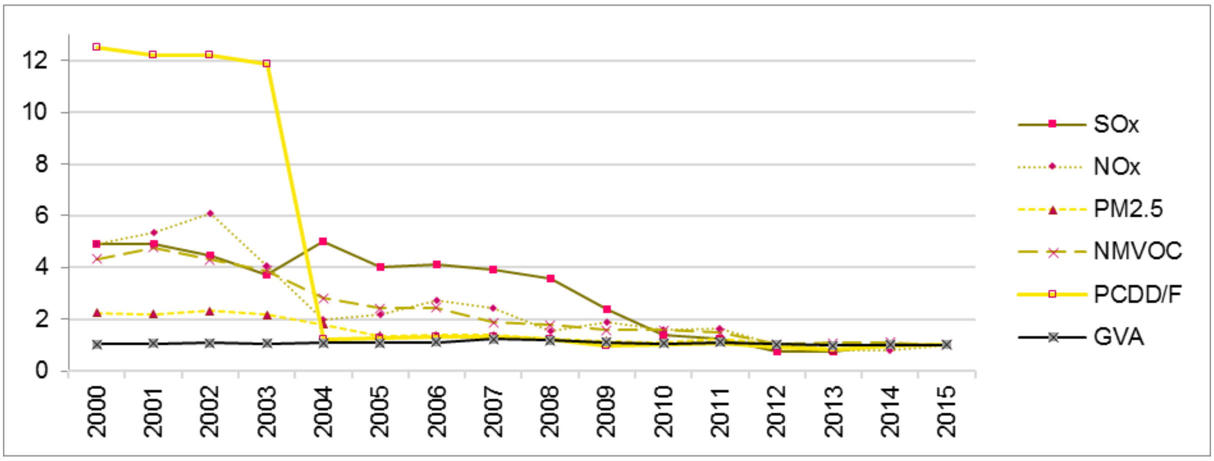


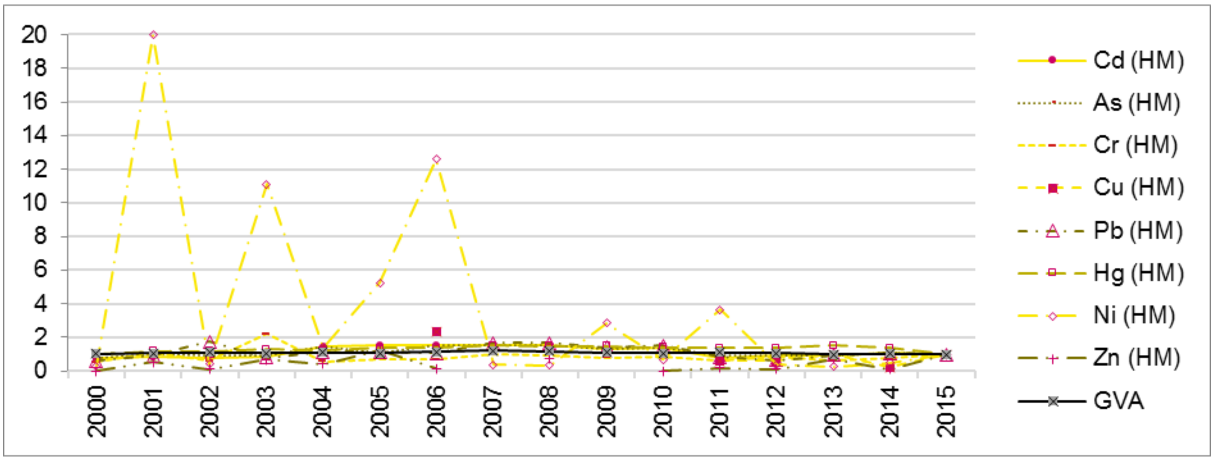
Note: $PM_{2.5}$ and Pb removed in charts above to make the detail visible for other pollutants.

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

Compared to a backdrop of relatively constant GVA for the mineral sector, emissions of SO_X, NO_X, NMVOC, $PM_{2.5}$ and PCDD/F from ceramic production (within the mineral - other sector) have decreased substantially between 2000 and 2015, with most of the decreases occurring during the 2000s (Figure 21, Figure 22). PCDD/F had a sharp decrease in 2004 and remains at a relatively constant level since then. SOx, NO_X, and $PM_{2.5}$ remain at constant low levels since 2010. Heavy metal emissions to air from the mineral - other sector since 2000 have mostly remained within 50% above and below 2015 levels during the period 2000 to 2015, and are not correlated with GVA development. This is with the exception of emissions of Ni which reportedly fluctuated substantially during the early 2000s; the cause of this is unclear. Cu is not reported for several years; excluding these years, there is a significant decrease in Cu air emissions since 2006.

Figure 21: Indexed emissions to air from the other mineral sector (indexed to 2015=1)

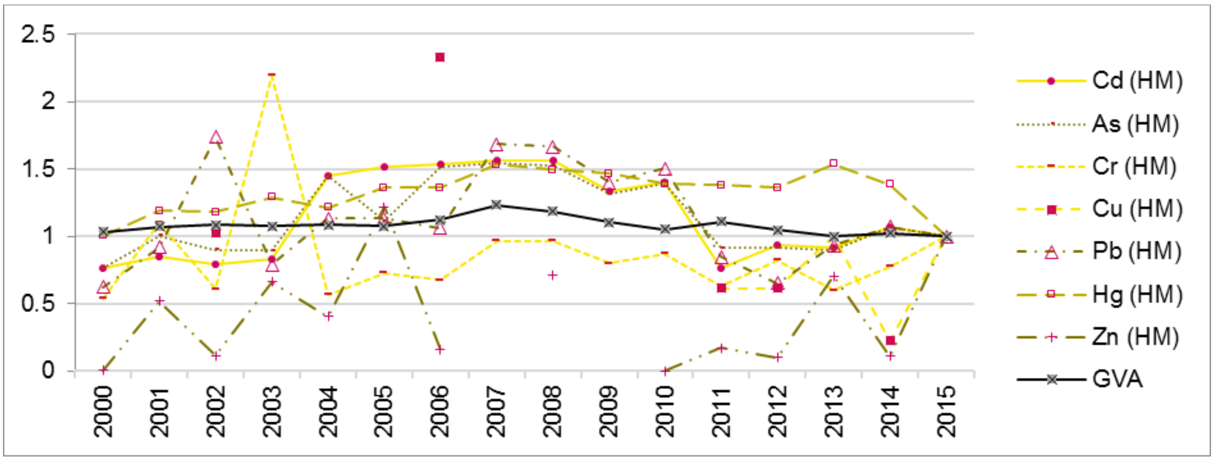




Note: No NH_3 reported. All heavy metals are reported (second chart). Note that the significant fluctuations in Ni emissions (second chart) are small in absolute quantity.

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

Figure 22: Indexed emissions to air of heavy metals from the other mineral sector (indexed to 2015=1) with outliers removed



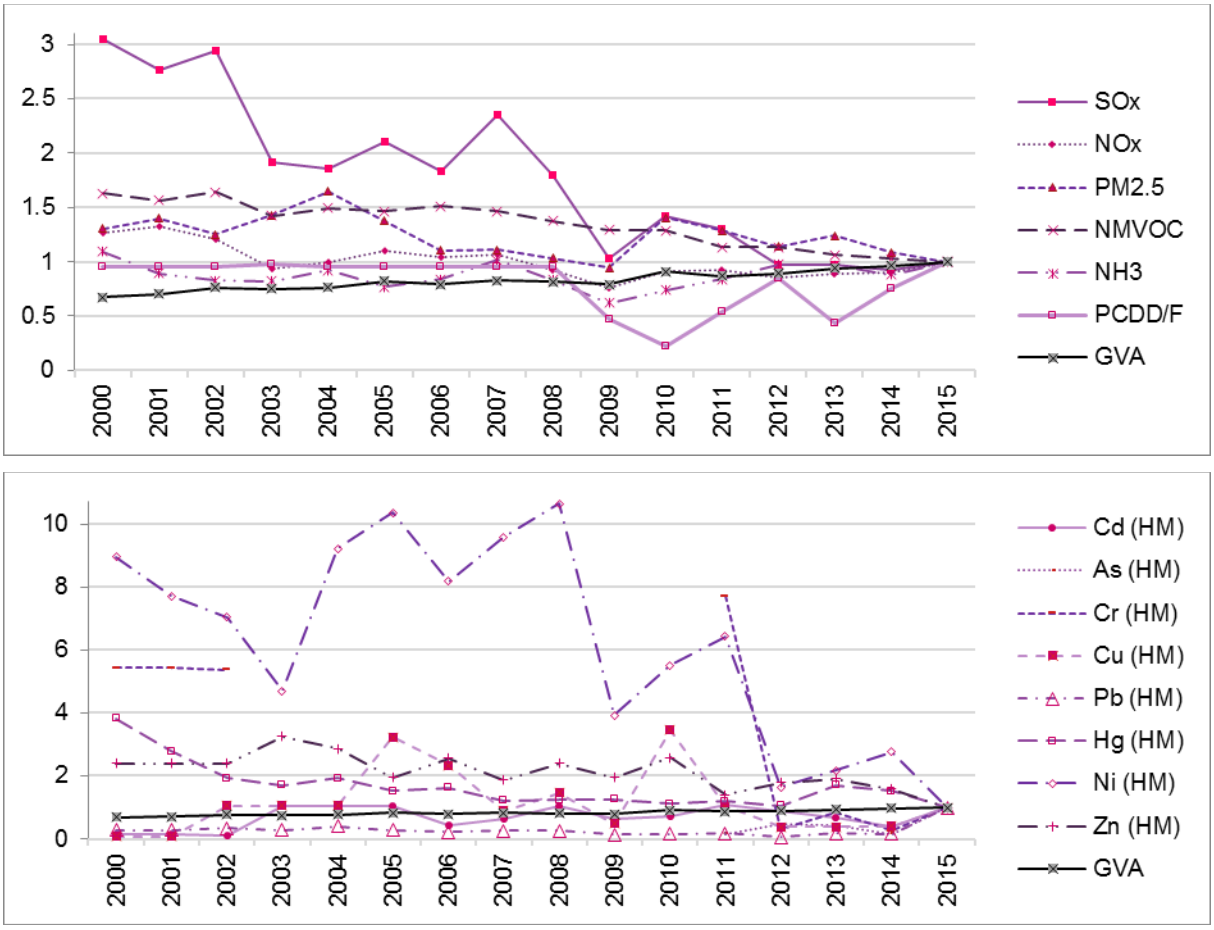
All heavy metals were reported but Ni is excluded to allow detail for other pollutants to be visible.

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

Chemical industry

Most pollutant emissions to air from the chemical industry follow a downward trend since 2000 with the exception of Pb which has increased and NH_3, PCDD/F and Cd emissions which remained almost level. Air emissions of SO_x, Ni, and Cr have also significantly decreased over time. These changes contrast with increasing GVA for the chemical sector over the fifteen-year period (Figure 23).

Figure 23: Indexed emissions to air from the chemical industry (indexed to 2015=1)



Note: As reported from 2011. Cr reported 2000-2002 and 2011-2015.

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

Waste management industry

In terms of absolute quantities of pollutants emitted, NO_X and PCDD/F are the important pollutants from **hazardous waste** compared to non-hazardous waste management in Belgium. Unlike for other sectors, pollutant emissions to air from the hazardous waste management sector have not decreased when comparing data from 2000 and 2015, with the exception of SO_X (Figure 24, Figure 25). For SO_x a drastic downward trend is reported between 2009 and 2010; the reason for the sudden drop in this year by a factor of 500 is unclear. The waste management sector exhibited strong growth in GVA during the period 2002 to 2012. For NH_3, only limited data were reported which are considered to be an outlier. Therefore, a new graph was provided excluding SO_x and NH_3 (Figure 25). The pollution level increased for NMVOC and $PM_{2.5}$ following the GVA increase over this period. However, significant peaks in $PM_{2.5}$ and NO_x emissions were reported in 2010, with elevated levels of $PM_{2.5}$ between 2009 and 2012. Afterwards, $PM_{2.5}$ air emissions decreased until 2015.

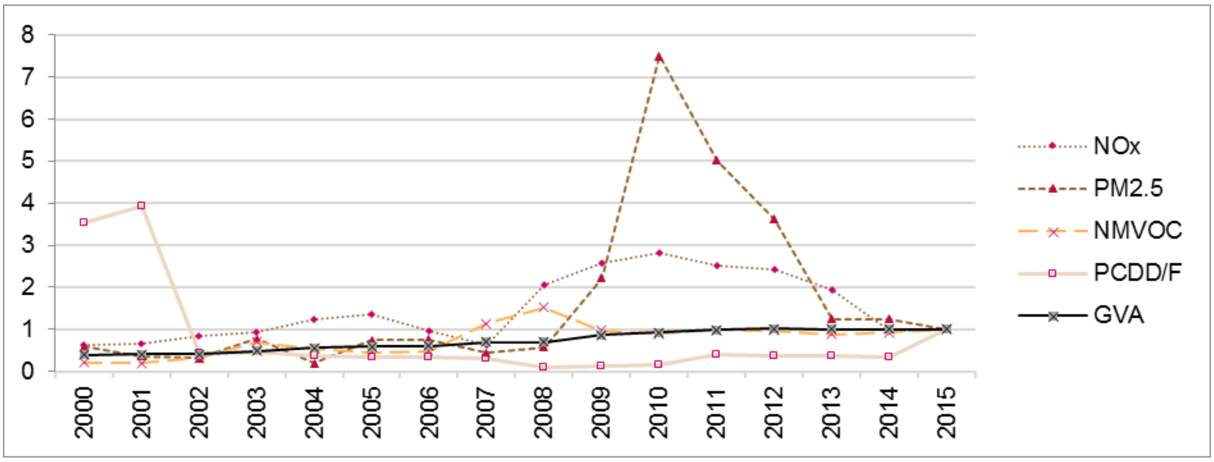
Data coverage for heavy metals is incomplete across the years: only Ni emissions were reported. Ni emissions remained relatively constant to 2011 and are not coupled to the GVA growth in that period. However, Ni emissions increased substantially in 2012. There was a slight increase of hazardous waste installations between 2011 and 2013 from 35 to 41, but this amount remained constant until 2015 unlike Ni emissions that dropped again after 2012.

Figure 24: Indexed emissions to air from hazardous waste (indexed to 2015=1)

Note: Ni is the only heavy metal reported (second chart).

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

Figure 25: Indexed emissions to air from hazardous waste (indexed to 2015=1) outliers removed



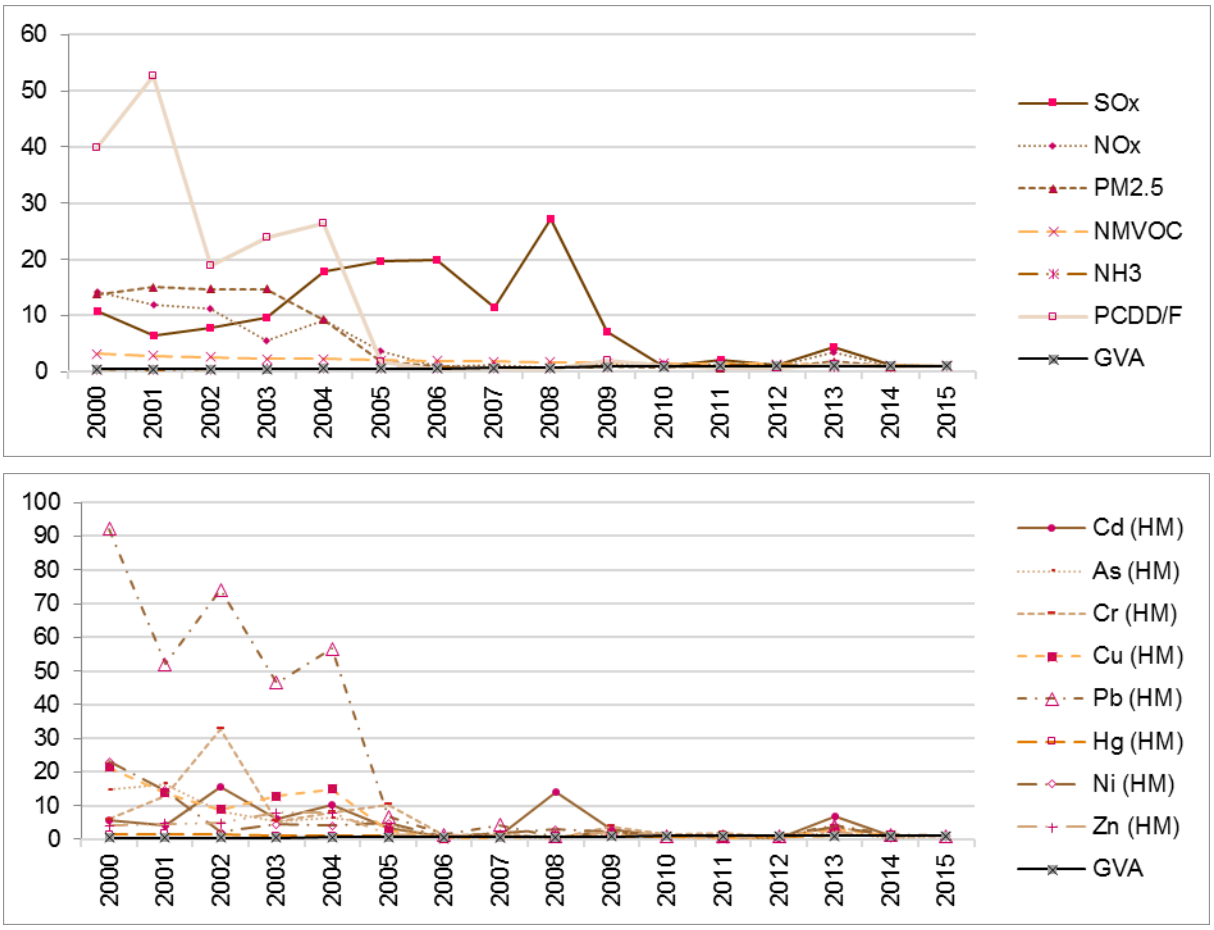
Note: chart excludes SO_x and NH_3 to make the detail visible for the other pollutants.

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

The declining trends in emissions of air pollutants is also observed for the **non-hazardous waste** management sector in relation to GVA for the sector as a whole (Figure 26). The largest relative decline of pollutant emissions between 2000 and 2015 was for PCDD/F and Pb, which are excluded from Figure 27 as their relative decreases dwarf the changes in other pollutant emissions. From 2006 onwards (for SO_x from 2010 onwards) emissions are much lower than before (see Figure 27 for detail). The reason for this substantive decrease is because the reporting of emissions from waste incinerators switched from 2006 to the energy sector because all the incinerators produced electricity from this date.

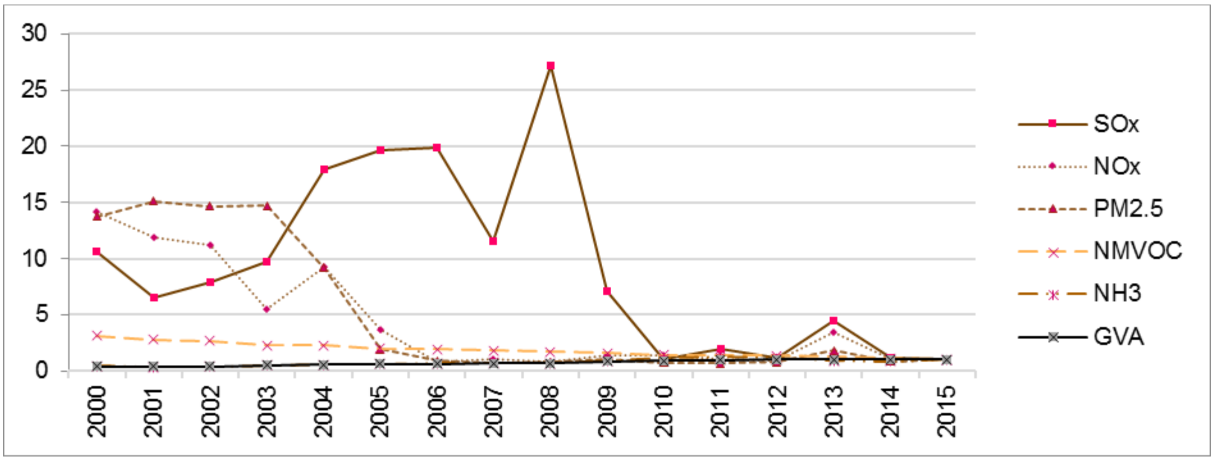
An exception to the decline in pollutants are NH_3 emissions which have doubled between 2000 and 2015, following a steady increase over the years, though not visible in Figure 26 due to the scale. However, the absolute quantities of NH_3 emitted remains small.

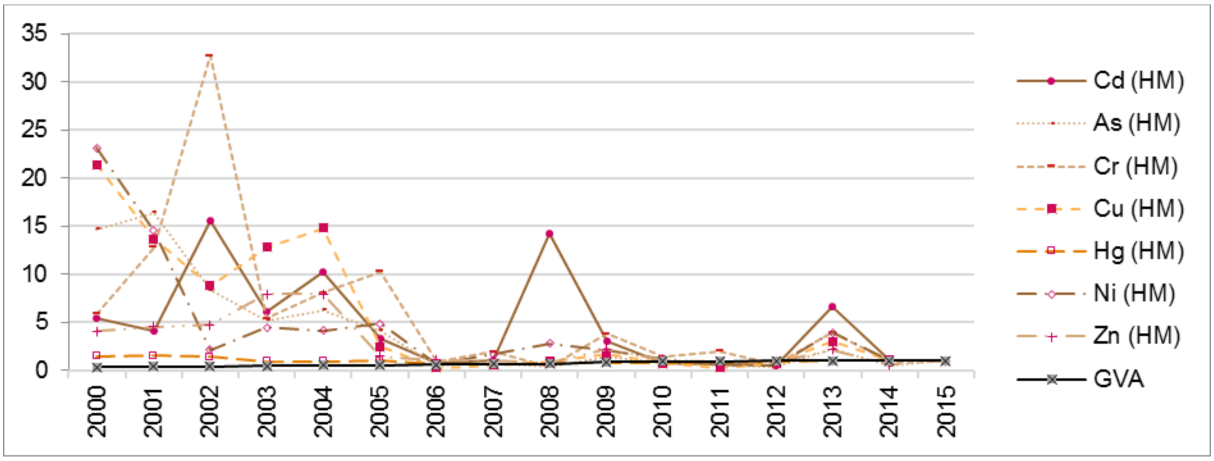
Figure 26: Indexed emissions to air from the non-hazardous waste management sector (indexed to 2015=1)



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

Figure 27: Indexed emissions to air from the non-hazardous waste management sector (indexed to 2015=1) with outliers removed





Note: Charts exclude PCCD/F and Pb to make detail for other pollutants more visible.

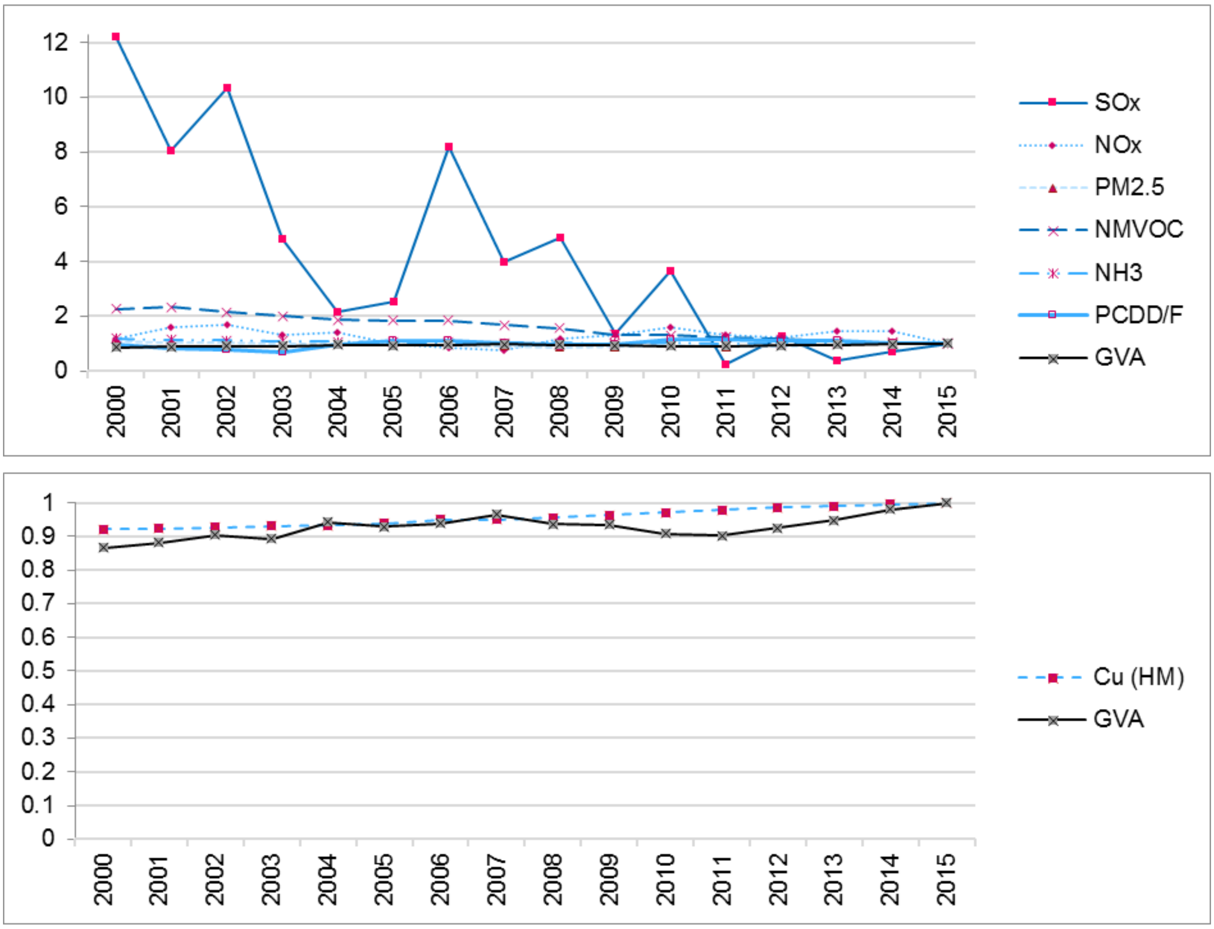
Source: EEA (2017a), Eurostat (2017a)

'Other activities'

In general, air pollutant emissions have declined over the 2000 to 2015 time period (Figure 28). The most significant pollutants are NMVOC and NH_3. The relative largest decline is reported for NMVOC emissions, which have more than halved in 15 years, which can mostly be attributed to the coating applications, food industry and printing in all years. NH_3 emissions have declined only slightly over this period, against the growth in GVA over this period. No change in the emission level is reported for PCDD/F where the level remains small and constant over time. The only heavy metal reported for Belgium is Cu, coming from firework (GoF 2018); the emission level of this pollutant is around 3t per year and has increased over time, approximately matching the trend in sector GVA. The only source of Cu emission within the 'other activities' sector is 'other product use'.

Smaller pollutant emissions totals sources have been reported for SO_x and NO_x, both of which have declined between 2000 and 2015; emissions are from the wood processing and chemical product sectors.

Figure 28: Indexed emissions to air from 'other activities' (indexed to 2015=1)



Note: For heavy metals only Cu is reported. 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. Furthermore, the pollutant scope for reporting to LRTAP does not include HCl or HF.

Table 6: Gaps in emissions to air data for Belgium

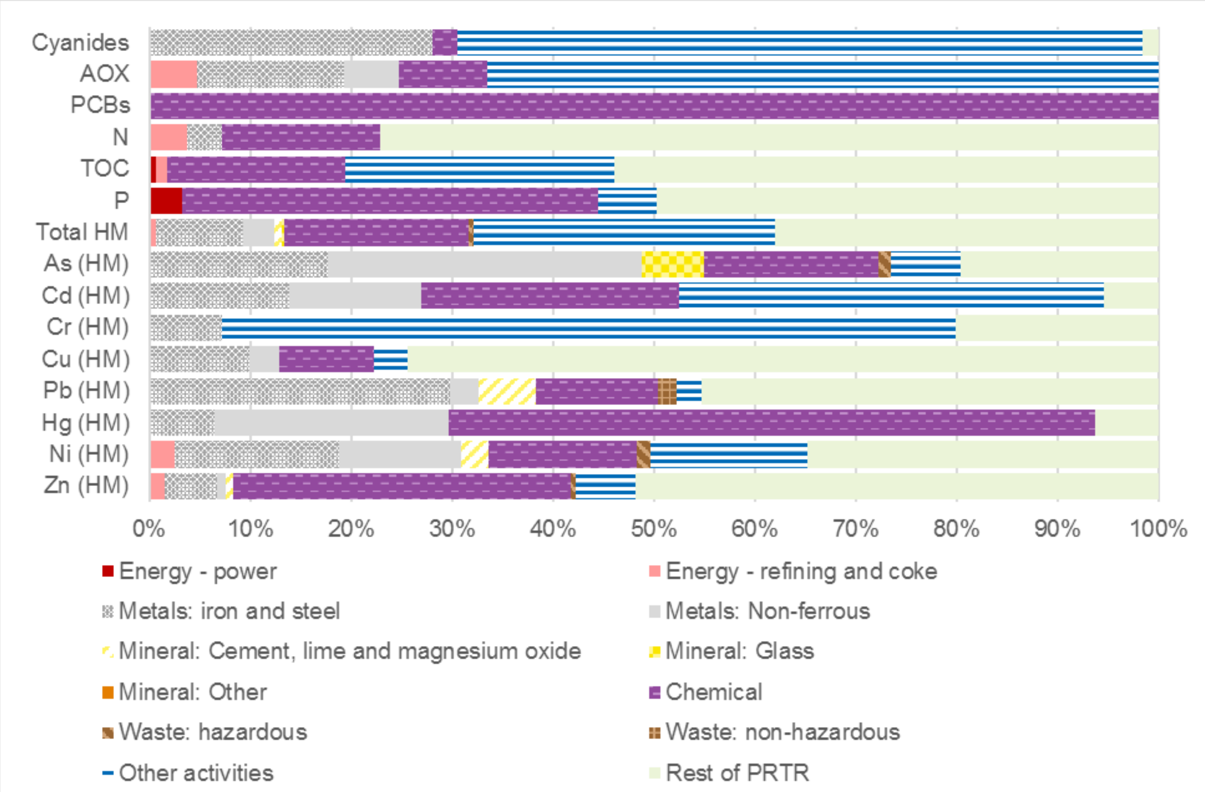
Missing data	Description	Conclusion and actions taken
Partial time series for certain pollutants and sectors	No extrapolation or interpolation undertaken as explained in the accompanying methodology paper.	No action
Data gaps	No data reported for the glass sector.	No action

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 29, aggregate the separate heavy metals into a single heavy metals metric based on their relative toxicity (reciprocal predicted no effect concentrations, PNEC) and expressed in Hg equivalent.

The available data of emissions to water for the year 2015 are shown in Figure 29. This plot presents, per pollutant, the proportion of emissions to water by the industrial sector compared to the data reported by Belgium to the E-PRTR in 2015. Compared to the totals reported in E-PRTR, the industrial sectors are reported to contribute significant proportions of emissions to water of cyanides, AOX, PCBs, TOC, total Phosphorus and total heavy metals. Among the industrial sectors, the largest contributions are from the metal industries, the chemical industry and 'other activities'.

Figure 29: Pollutant emissions to water from industrial sectors and rest of PRTR total (2015)



Note: Rest of PRTR total relates to the total for E-PRTR reporting minus the industrial sectors shown here. No data are reported for the Mineral: other sector. Diuron excluded from the chart as not reported by any industrial sector.

Source: EEA (2017b)

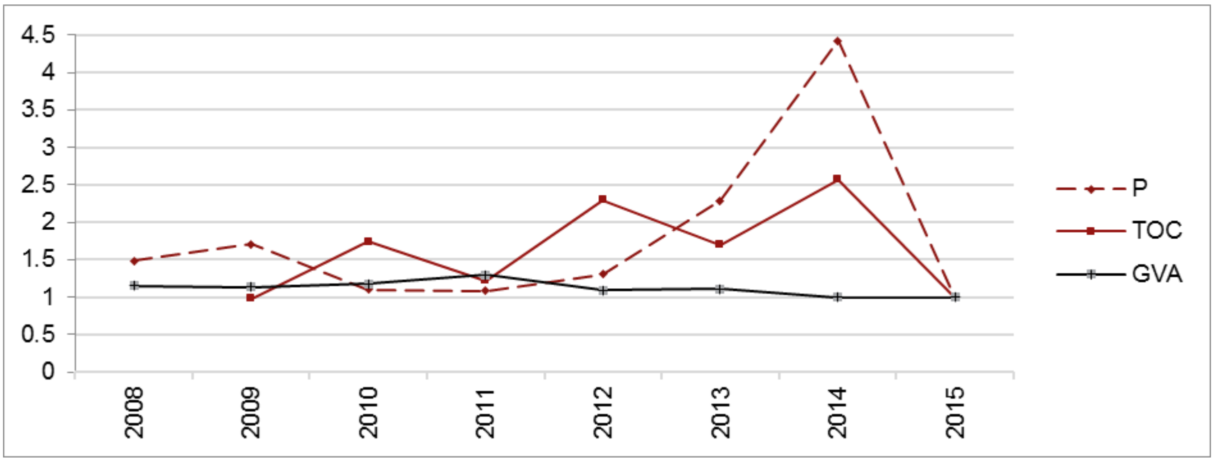
In the following subsections, emissions data are shown in indexed charts by sector. This was done to compare the development of pollutant emissions with the GVA in specific sectors in the time period 2007 to 2015.

For most industrial sectors, there is sufficient data over the time series to show a trend in the reported emissions to water; these are shown in the subsequent subsections. The mineral and waste management sectors are not shown here however, because of limited data and/or insignificant emission quantities. Full details on the emissions reported by industrial sector and year are however presented at the end of this section in Table 7.

Energy industry

In the energy - power sector, emissions to water were reported for some heavy metals, total P, TOC and total N; however, emissions were not reported for all years. As only emissions for total P and TOC were available for 2015, only these pollutants could be indexed to 2015 (Figure 30). Considering the years from 2009 to 2015 total P and TOC emissions have almost maintained their level with strong increases between 2012 and 2014. In 2015 emission levels dropped compared to 2014.

Figure 30: Indexed emissions to water from the energy - power industrial sector (indexed to 2015=1)

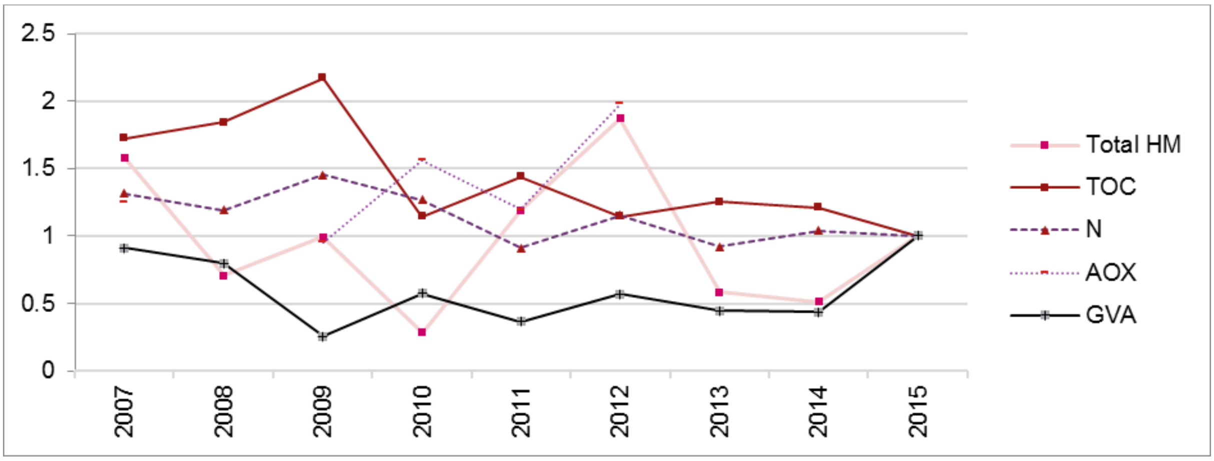


Note: No data were reported for PCBs, PCDD/Fs, total N, diuron, AOX, cyanides or heavy metals over a continuous time period including 2015. No 2007 data for total P and TOC; no 2008 data for TOC.

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

Emissions to water from the energy - refining industrial sector are reported for the heavy metals Zn, Ni and As (in the graph represented as total heavy metals, aggregated by toxicity as Hg equivalent), TOC, total N and AOX (Figure 31), however, not for every year. The trends in GVA and pollutant emissions fluctuate over the period 2007 to 2015, with no obvious correlation.

Figure 31: Indexed emissions to water from the energy - refining and coke sector (indexed to 2015=1)



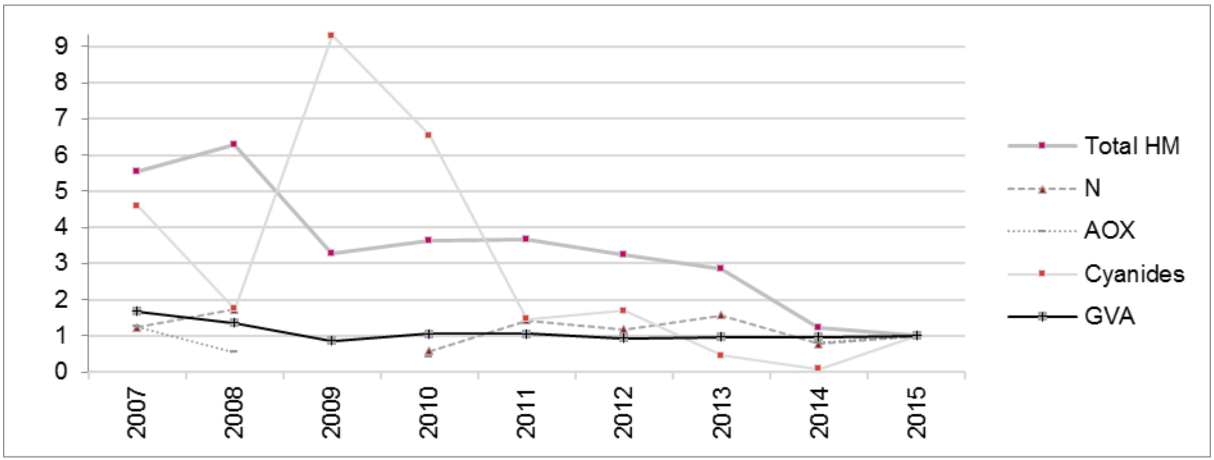
Note: no data were reported for PCBs, PCDD/Fs, total P, diuron or cyanides over a continuous time period including 2015.

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

Metal industry

In the iron and steel sector, for the key pollutants cyanides and total heavy metals, emissions to water levels have significantly decreased for both pollutants between 2007 and 2015, although important peaks were reported in 2008 and 2009-2010 for total heavy metals and cyanides respectively (Figure 32). AOX and N water emissions have not changed substantially when comparing 2007 levels to 2015. Also across this time period the GVA has declined slightly.

Figure 32: Indexed emissions to water from the iron and steel industrial sector (indexed to 2015=1)

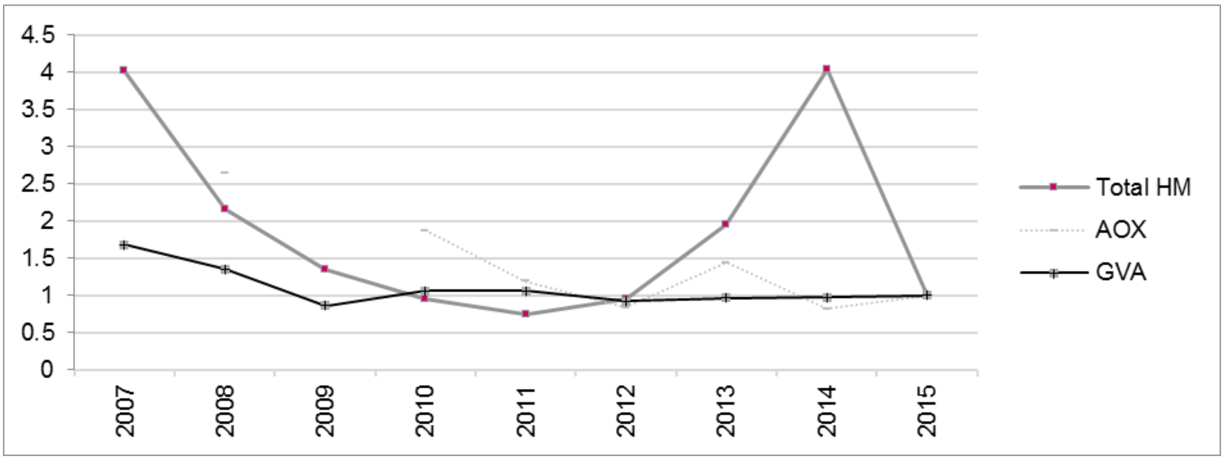


Note: Total P, PCBs and diuron were not reported at all. TOC and PCDD/F were reported for some years but cannot be displayed as no 2015 data were reported. No reported AOX emissions in 2009, or between 2011 and– 2013, and no total N data for 2009 and so these points are not plotted in the chart to avoid misrepresenting trend lines.

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

Emissions to water from the –non-ferrous metal sector are reported continuously for most of the heavy metals (in the graph represented as total HM, aggregated by toxicity as Hg equivalent) and for AOX (Figure 33). AOX decreased over time similarly to the GVA. For total heavy metals, emissions decreased from 2007 to 2011 but subsequently increased to a peak in 2014. The increase is mainly from higher As and Cd emissions in 2013 and 2014 respectively.

Figure 33: Indexed emissions to water from the non-ferrous metals industrial sector (indexed to 2015=1)



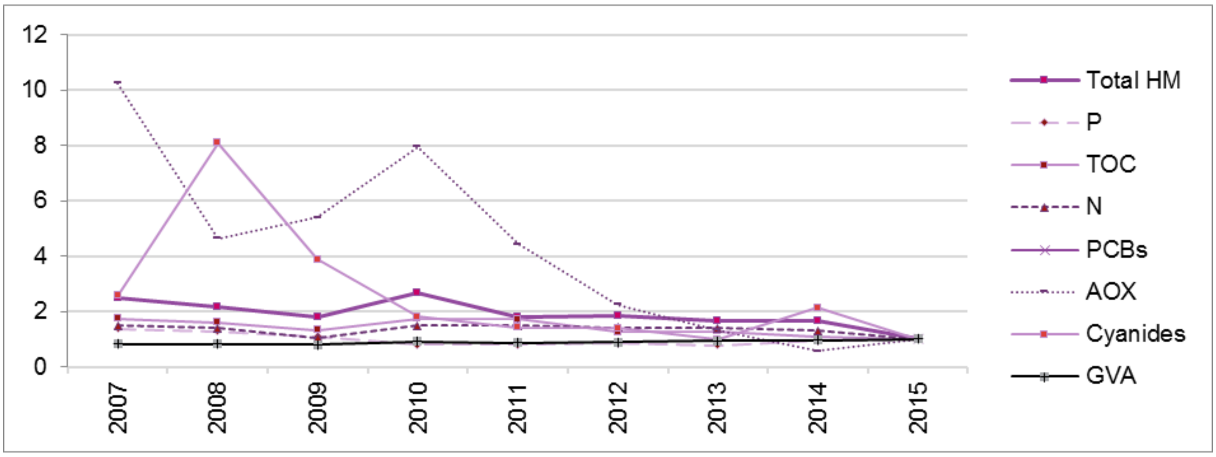
Note: Total P, PCBs, PCDD/F, diuron and cyanides were not reported at all. Total N and TOC were reported for some years but cannot be displayed as no 2015 data were reported. No reported AOX emissions in 2007 or 2009and so these points are not plotted in the chart to avoid misrepresenting trend lines.

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

Chemical industry

Emissions to water from the chemical industrial sector mainly come from the production of organic and inorganic chemicals. Emissions to water were reported for all pollutants covered here except for Cr, PCDD/F and diuron, whereas PCB emissions were only reported for 2015 (Figure 34). Almost all pollutant emissions decreased over time. For cyanides and AOX it is a more significant decrease, including variations, between 2007 and 2012. By comparison, the sector GVA increased slightly over this period and the number of permitted IED installations increased significantly for 2011 to 2015.

Figure 34: Indexed emissions to water from the chemical industrial sector (indexed to 2015=1)



Note: PCDD/F and diuron were reported for some years but cannot be displayed as no 2015 data were reported. PCB emissions only reported in 2015 and so no trend line visible.

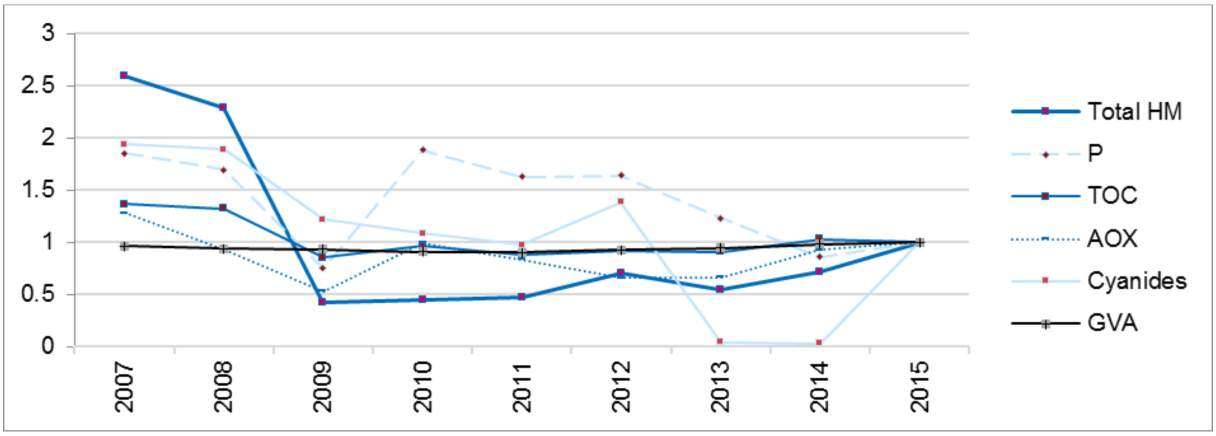
Source: EEA (2017b), Eurostat (2017a)

'Other activities'

Surface treatment activities, pulp and paper production, independently operated waste water treatment, pre-treatment or dyeing of textiles and treatment and processing of animal or vegetable raw materials are the main sources of emissions within 'other activities'. No emissions are reported for intensive rearing of poultry and pigs, despite reported permits for 859 IED installations in 2015. The main contribution to pollutant emissions is from pulp and paper production.

In 2015, emissions to water were reported for total P, TOC, AOX, cyanides and for all heavy metals except Hg. Emission trends of these pollutants from 2007 onwards show a decline, subject to fluctuations year on year, as shown in Figure 35. Total heavy metals for example drop to its lowest level in 2009 before increasing again. The GVA is approximately flat over the period 2007 to 2015.

Figure 35: Indexed emissions to water from the 'other activities' industrial sector (indexed to 2015=1))



Note: No data were reported in 2015 for Hg, total N, PCDD/F, PCB or diuron. GVA data does not include intensive rearing of poultry or pigs within 'other activities'.

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

Additional data for emissions to water

Additional data reported to E-PRTR for emissions to water are presented in Table 7 – including for pollutants with no time series presented in the above graphs.

Table 7: Emissions to water by pollutant and industrial sector (all available data)

		2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - power										
Total HM	kg	1.96	9.52	152.15	8.60	0.62	1.48	-	138.91	-
P	t	-	27	31.08	20	19.7	23.7	41.7	80.5	18.2
TOC	t	-	-	56.6	100	70.3	132	97.5	148	57.5
N	t	-	-	77.3	141	60.3	56.1	55.6	104	-
Energy - refining, gasification and liquefaction, coke										
Total HM	kg	13.17	5.91	8.26	2.39	9.96	15.59	4.87	4.26	8.33
P	t	-	-	-	-	-	6.64	-	-	-
TOC	t	158	169	199	105	132	105	115	111	91.6
N	t	163	148	180	157	113	143	114	129	124
AOX	kg	1,400	-	1,070	1,750	1,340	2,220	-	-	1,120
Cyanides	kg	-	-	307	224	149	-	-	-	-
Metals: iron and steel										
Total HM	kg	595.64	675.98	350.11	388.33	393.14	347.70	305.61	132.55	107.24
TOC	t	219	80.5	80.5	288.6	189	740	70.8	-	-
N	t	141.5	197.5	-	66	163.9	134.2	179.6	88.8	114
PCDD/F	kg	0.0003	0.01	-	-	-	-	-	-	-
AOX	kg	4,340	1,900	-	1,390	-	-	-	2,770	3,450
Cyanides	kg	4,478	1,700	9,050	6,356	1,426	1,650	436	84	972
Metals: Non-ferrous										
Total HM	kg	152.23	82.08	51.00	36.06	28.49	35.76	74.12	152.78	37.88
TOC	t	55.5	63	-	51.2	-	58.2	63.6	-	-
N	t	-	59.1	-	-	-	-	-	-	-
AOX	kg	-	3,460	-	2,450	1,560	1,090	1,890	1,070	1,310
Mineral: Cement, lime and magnesium oxide										
Total HM	kg	5.18	-	-	-	28.58	2.21	20.98	0.46	8.76
P	t	-	-	-	-	-	5.76	-	-	-
N	t	-	-	-	-	-	-	644	-	-
Mineral: Glass										
Total HM	kg	1.08	1.59	6.59	0.53	-	-	-	2.52	3.88
Chemical										
Total HM	kg	569	487	409	605	412	416	374	379	227
P	t	312.69	291.04	249.36	181.74	184.64	194.61	177.62	214.29	228.87
TOC	t	2,557	2,358	1,963	2,561	2,544	1,866	1,884	1,604	1,476
N	t	776.2	739	547	778	781.8	748.7	734	680.9	524.7
PCBs	kg	-	-	-	-	-	-	-	-	0.74
PCDD/F	kg	-	-	-	-	-	0.0001	-	-	-
AOX	kg	21,210	9,590	11,190	16,440	9,180	4,660	2,740	1,170	2,070
Diuron	kg	-	-	-	4.24	2.98	2.71	-	-	-
Cyanides	kg	220	691	331	155	122	120	84	182	86
Waste: hazardous										
Total HM	kg	43.45	20.58	5.03	11.93	21.31	5.38	67.56	39.92	3.36
TOC	kg	-	97,700	-	-	-	89,800	-	-	-
Waste: non-hazardous										
Total HM	kg	37.67	2.58	14.14	-	13.01	-	2.99	26.16	1.42
PCBs	kg	-	-	-	-	0.33	-	-	-	-
PCDD/F	kg	-	0.001	0.001	-	-	-	-	-	-
Other activities										
Total HM	kg	962	850	158	167	176	260	202	266	370
P	t	60.14	55	24.3	61.13	52.7	53.18	40	27.8	32.42
TOC	t	3,063	2,971	1,910	2,177	1,985	2,051	2,032	2,314	2,241
N	t	159	132.1	142.5	252.8	323.4	85	90	69.4	-
AOX	kg	20,210	14,640	8,360	15,670	13,200	10,430	10,480	14,620	15,770
Cyanides	kg	4,570	4,450	2,870	2,561	2,307	3,266	100	79	2,357

Source: EEA (2017b). Total heavy metals is calculated in Hg equivalents using reciprocal predicted no effect concentrations.

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 reporting thresholds which apply (as well as inconsistencies between years). E-PRTR also has a limited timeseries.

Table 8: Gaps in emissions to water data for Belgium

Missing data	Description	Conclusion and actions
Gaps in time-series	No gap-filling for emissions data has been carried out – as explained in the accompanying methodology paper	No action
Missing pollutants	Often data are reported per industrial sector for only a few pollutants	No action
Missing sectors	No data reported for the mineral - other sector	No action

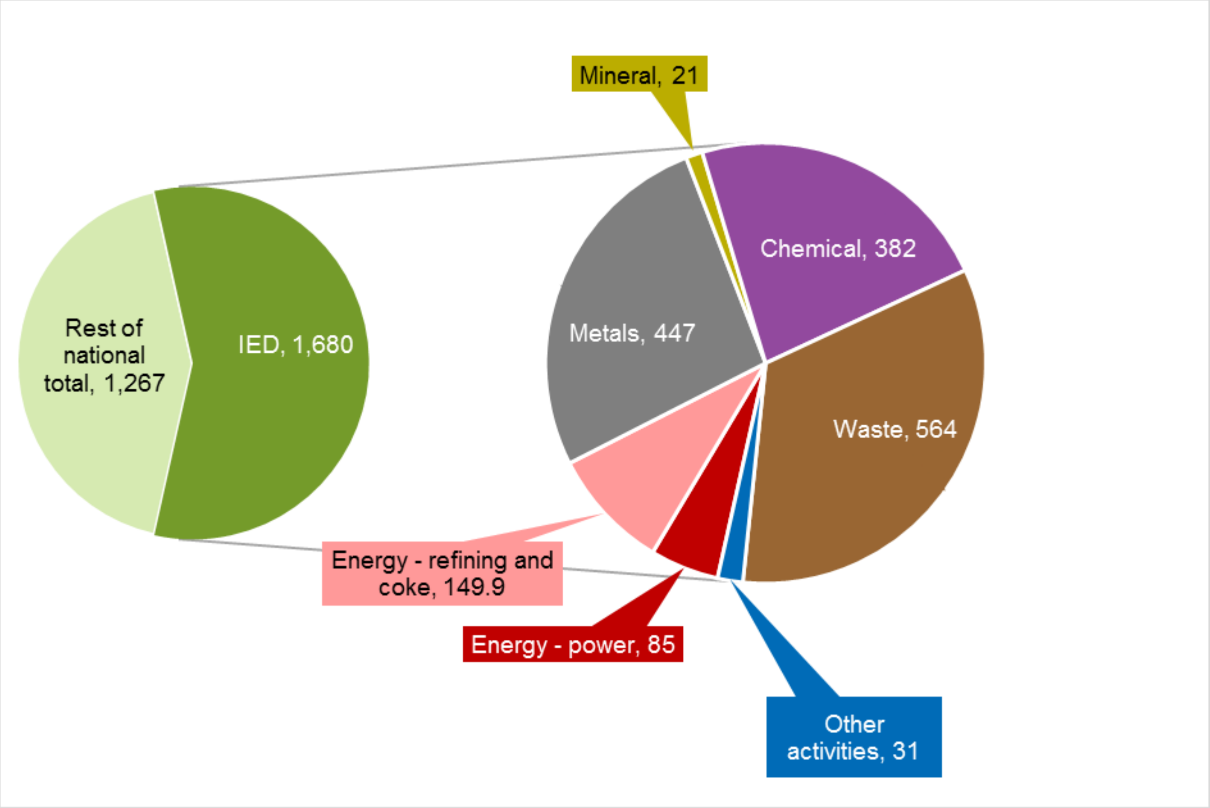
5 Waste generated by industrial sectors

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 Belgium (Figure 36). Of this, the waste management, metals and chemicals industrial sectors generate the largest quantities of hazardous waste.

The quantity of hazardous waste generated by the metal industrial sector in Belgium is relatively large compared to the number of permitted IED installations. However, the data provided by Eurostat also includes the manufacturing of equipment which is not covered by IED and will likely lead to an overestimation.

Figure 36: Hazardous waste generation by industrial sector in 2014 (kt)

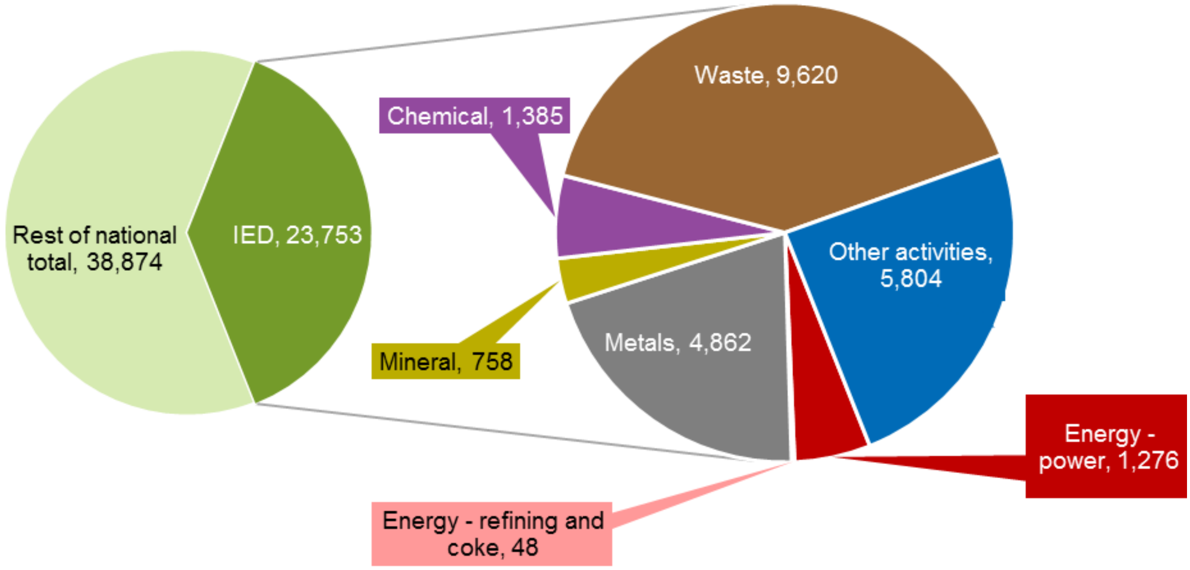


Note: Rest of national total relates to all NACE activity minus industrial sectors shown here. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.

Source: Eurostat (2017e)

Industrial sectors also account for a significant share of total non-hazardous waste generated (Figure 37) – with the metal industrial sector again accounting for a considerable amount of this. The largest quantity of waste generated is by the waste management sector itself. Typical waste streams that require disposal from this sector include a mixture of ash, carbon and lime residue, bottom ash, leachate, bioaerosols and discards.

Figure 37: Non-hazardous waste generation by industrial sector in 2014 (kt)



Note: Rest of national total relates to all NACE activity minus the industrial sectors shown here. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.

Source: Eurostat (2017e)

Between 2004 and 2014, the quantity of waste generated has slightly increased or stayed the same in 2014 compared to 2004, with some variations. These variations are especially obvious for the mineral, chemicals and waste industrial sectors, where peaks are indicated for 2006 and 2012, mainly for non-hazardous but also for hazardous waste generation. The reasons for these peaks are not clear.

In the metals industrial sector hazardous waste generation reduced significantly, following the smaller relative decrease in GVA for this sector.

For the 'other activities' sector, a large increase in hazardous waste generated occurred with a peak in 2012 before falling to 2014 levels that were similar to 2006 levels. Non-hazardous waste generated by 'other activities' followed the same trend as GVA.

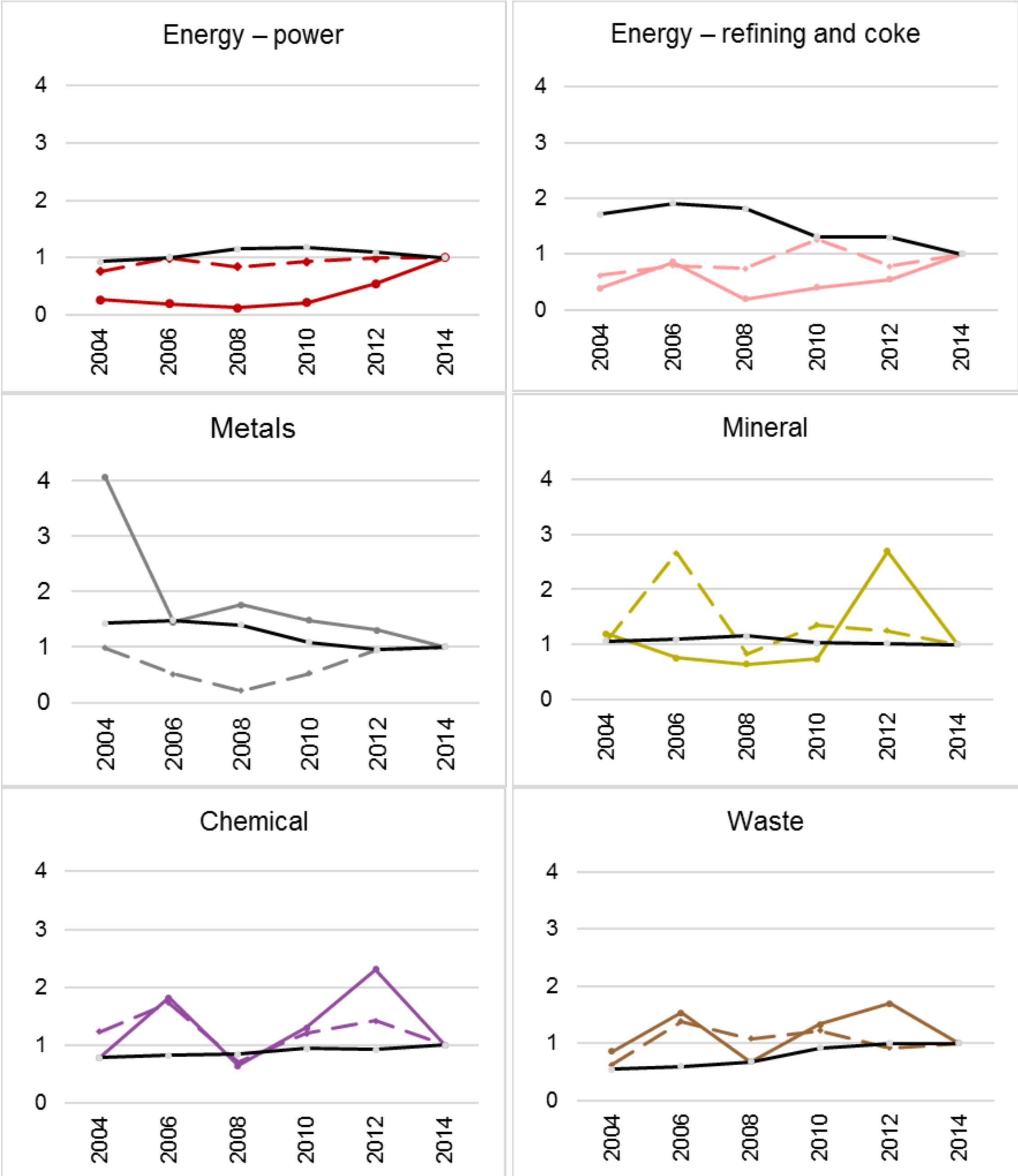
Limitations

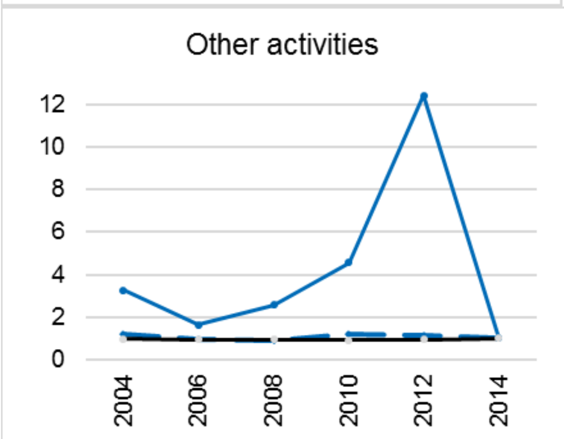
The use of NACE classifications for reporting has generally led to overreporting for waste generation data against each industrial sector compared to a scope strictly limited to the IED. No data could be included within 'other activities' to reflect the IED activity intensive rearing of poultry or pigs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

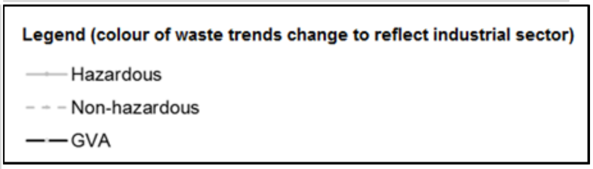
No national data gaps identified for the waste generation data.

Missing data	Description	Conclusion and actions
No IED installations reported for tanning [of leather] IED activity	The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.	No action

Figure 38: Hazardous and non-hazardous waste generation by industrial sector relative to GVA (indexed; 2014 = 1)







Note: Different axis used for 'other activities' compared to other industrial sectors. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are permitted for tanning, the data cannot be excluded for this activity.

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

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 analysis[2].

As shown in section 2, key industries in Belgium in terms of the number of permitted IED installations in 2015 are intensive rearing of poultry and pigs, chemicals, non-hazardous waste management and the energy - power sector.

The two industrial sectors identified in section 4 as contributing the largest burden to the environment for emissions to air of the majority of pollutants were the energy-power and metals sectors. In addition, the energy-refining and coke sector, chemicals sector, cement, lime and magnesium oxide sector, and the 'other activities' sector also have significant environmental burdens for specific pollutants to air.

The metals, chemicals and 'other activities' sectors were identified as having significant environmental burdens for emissions to water in Belgium. The metals, chemicals and waste management industrial sectors generate the majority of Belgium's industrial hazardous waste.

In addition to the quantitative identification of key industries, details on political and environmental challenges and pressures related to IED industrial sectors[3] have been sought.

Stakeholders from the relevant authorities of all three regions Flanders, Brussels and Wallonia were consulted to discuss the challenges and pressures identified through desk-based research as well as further challenges and pressures. One general challenge across all three regions was identified. One challenge specific for Flanders has been identified which is in the scope of this project. The two other regions mentioned challenges related to the implementation of the IED which were not further investigated.

Wallonia: There are no challenges directly related to specific sectors covered by the IED. Some sectors comply with stricter limit values than defined by the BREFs: glass manufacturing (IED activity 3.3) and the cement sector (activity 3.1) follow stricter POP limit values.

Brussels: The region is very small and has only a limited number of IED installations: 2 for metal surface treatment, 1 slaughterhouse, 2 large combustion plants, lead recycling, food production facilities, and 1 waste incinerator which is a best practice example in terms of emissions. In general, the region tries to implement the same high standards that are defined by the Flanders region in their local BATs. One problem mentioned by the authorities was in relation to the implementation of the IED and so has not been listed as a challenge (this was that the companies have problems in the financing of the prescribed audits and proper waste management).

For **Flanders** one challenge identified is cross-cutting because it is related to all IED sectors. The challenge is that local Flemish standards are sometimes stricter than the upper BAT-AEL range The population density and spatial planning in Flanders can be a challenge across all sectors, because most facilities are located close to settlements. This can cause problems hence why local General Binding Rules (GBR) and permit conditions include stricter limit values. In total, Flanders has 1,650 IED installations (based on data from 2017). The largest sector in Flanders is the IRPP sector (IED sector 6.6 Intensive rearing of poultry or pigs). There are around 829 IED installations for IRPP, 370 for pigs and 459 for poultry. Due to its high number of installations (and a lot of non-IPPC installations), although strictly regulated, there is environmental pressure from this sector. However, the sector is regulated by strict GBR set out in the permits that the installations meet and so it is not considered as a challenge by the authorities. The second largest industry sector is the chemical sector with 170 IED installations mostly located around the Albert-canal and the harbours of Ghent and Antwerp.

Table 9: Key challenges identified in Belgium

[2] The challenges and pressures included here do not concern the implementation of the IED.

[3] These difficulties do not concern the implementation of the IED.

Installations typically need to meet strict standards in Flanders, when more than the BREF BAT-AELs is required	*BE-1*
IED activities / sectors	All IED sectors
Medium and pollutants	N/A
Description	In general, BAT conclusions are transposed in local Flemish legislation as General Binding Rules (GBR) and all permits are updated in a 4-year period. For the transposition of BAT conclusions, local BAT-studies (covering also non-IED activities) are conducted that sometimes propose stricter limit values and more detailed descriptions of techniques than the BREF document at EU level, e.g. for water emissions or in waste treatment. The industry uses the BREFs to challenge local BAT-conclusions (in local BAT-studies), using terms like 'gold plating'. However, stricter ELVs are sometimes needed because of local issues and/or to comply with other regulations (e.g. WFD). In Flanders, the Flemish Knowledge Centre for Best Available Techniques (BAT-knowledge centre) is an initiative from the Flemish Region and VITO. The BAT-knowledge centre collects and distributes information concerning environmentally and energy friendly techniques in industrial processes and selects the Best Available Techniques for several sectors. The BAT-knowledge centre is responsible for drafting local BAT studies. The BAT studies contain recommendations for the environmental permit conditions and regulation (VLAREM), ecology premium and further research. Studies are established in a process where both the industry and the government are involved. Documents are either newly established for emerging sectors or they are being revised because they are outdated. However, for new emerging sectors, the industry positively supports the Flemish Region and VITO in establishing the BAT documents as they provide a Flemish level playing field. These BAT-studies mostly aren't covered at EU level, e.g. bunding for aboveground storage of dangerous liquids; LNG/LBG storage, distribution and bunkering; prevention and reduction of amalgam (mercury alloy) containing effluent in dental practices etc.
Years applicable / current	Continuous
Related infringement cases	No
Public complaints	None.
Media Attention	Complaints not expressed via the media.
Political interventions	N/A
Policies implemented to address challenge	N/A
Related policies	N/A
References	Vlaamse overheid, Departement Omgeving, Afdeling Gebiedsontwikkeling, Omgevingsplanning en - Projecten

High population density close to IED facilities	*BE-2*
IED activities/ sectors	IED activities in general in all 3 regions
Medium and pollutants	N/A
Description	All three regions (Flanders, Wallonia, and Brussels) are characterised by a high population density and dispersed spatial planning due to the historical development of industry in Belgium. Production sites can be located close to municipalities. For this reason, complaints by the inhabitants are experienced. This can be regarded as a cross-cutting industry challenge, because a lot of IED facilities in Belgium are located close to settlements, which can cause more problems than it might elsewhere. Complaints are investigated and dealt with by the local/regional inspection agencies. They try to resolve the issues that can lead to stricter permit conditions, to lower the environmental burden. Practices and procedures may vary in the 3 regions of Belgium. Examples of complaints are: - Odour complaints - Public needs reassurance on ELV
Years applicable / current	Continuous
Related infringement cases	No
Public complaints	Public is involved in permitting procedure where complaints are evaluated and can lead to stricter permit conditions. If afterwards there is still an unacceptable pollution, the public can file a complaint and the local inspection agency deals with it.
Media Attention	Due to the number of different cases no links are provided.
Political interventions	There is constant dialogue with the inhabitants and complaints are investigated by the authorities when there is evidence that permit breaches do occur. If deemed necessary the permit conditions can be updated to lower the environmental impact of installations. In general, the population and the environment in Belgium are protected by strict emission limit values, and when needed (EQS, spatial issues etc.), they can be stricter than required by the EU legislation.
Policies implemented to address challenge	In Flanders local GBR and permit conditions can define strict limit values. The other regions also can fix strict limit values in individual permits. To deal with complaints all regions have a similar approach.
Related policies	N/A
References	Vlaamse overheid, Departement Omgeving, Afdeling Gebiedsontwikkeling, Omgevingsplanning en – Projecten Walloon DG Agriculture, Natural Resources and Environment

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Appendices

Appendix 1 - Mapping industrial sectors across data sources for Belgium

Industrial sector †	GVA	Employment	Energy consumption ‡	Water consumption	Emissions to air	Emissions to water ^	Waste generated
	Eurostat (2017a)	Eurostat (2017b)	Eurostat (2017c)	Eurostat (2017d)	EEA (2017a)	EEA (2017b)	Eurostat (2017e)
Sector classification	*NACE Rev 2*	*NACE Rev 2*	*Energy balance indicator*	*NACE Rev 2*	*NFR14 sector classification*	*E-PRTR*	*NACE Rev 2*
Time series available	*2000-2015, annually*	*2008-2015, annually*	*2000-2015, annually*	*2000-2015, annually*	*2000-2015, annually*	*2007-2015, annually*	*2004-2014, every 2 years*
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	*No data reported*	D (electricity, gas, steam and air conditioning supply)
Energy: refining, gasification and liquefaction, coke	C19 (coke and refined petroleum products)	C19 (coke and refined petroleum products)	B_101307 - Petroleum Refineries; B_101312 - Consumption in 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)	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	C24 (basic metals)	2C1 Iron and steel	*No data reported*	C24-C25 (basic metals; fabricated metal products, except machinery and equipment)
Metals: non-ferrous			B_101810 - Non-Ferrous Metals		2C2-7 Non-ferrous metals	*No data reported*	
Mineral: Cement, lime and magnesium oxide	C23 (non-metallic mineral products)	C23 (non-metallic mineral products)	B_101820 - Non-Metallic Minerals	*Insufficient granularity in reported data*	2A1 Cement; 2A2 Lime	Cement, lime and magnesium oxide (3c)	C23 (non-metallic mineral products)
Mineral: Glass					2A3 Glass	*No data reported*	
Mineral: Other					2A6 Other	*No data reported*	
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 (4b; e)	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)	*Unavailable*	*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	Disposal or recovery of 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 (5d)	
Other*: Food and drink products	C10-C12 (food and drinks and tobacco)	C10 (food products); C11 (drink products)	B_101830 - Food and Tobacco	**DATASETS COMBINED:** C10-12 (food and drinks and tobacco); C13-15 (textiles; wearing apparel; leather); C16-17 (paper and wood products)	2H Food and beverages industry	Food and drink (8b/c)	C10-C12 (food products; drink products; tobacco)
Pulp, paper and wood-based products	C16-17 (paper, paper products and wood-based products)	C16-17 (paper, paper products and wood-based products)	B_101840 - Paper, Pulp and Print		2H1 Pulp and paper industry	Pulp, paper and wood production (6a-c)	C16-C18 (paper, paper products and wood-based products; printing)
Textiles	C13-C15 (textiles; wearing apparel; leather)	C13 (textiles)	B_101835 - Textile and Leather		*Unavailable*	Pre-treatment or dyeing of textile fibres or textiles (9a)	C13-C15 (textiles; wearing apparel; leather)
Intensive rearing of poultry and pigs	*Unavailable*	*Unavailable*	*Unavailable*	*Unavailable*	3B3 Manure management – Swine; 3B4gi Manure management - Laying hens; 3B4gii Manure management - Broilers	*No data reported*	*Unavailable*
Surface treatment	*Unavailable*	*Unavailable*	*Unavailable*	*Unavailable*	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 using organic solvents (9c)	*Unavailable*
Rest of national total	*All NACE activities*	*All NACE activities*	*B_100900 – Gross inland consumption*	*All NACE activities*	National total for the entire territory (based on fuel sold)	*Total for all E-PRTR activities reported*	*All NACE activities plus households*

Notes:
† Number of IED installations is reported against IED activities for years 2011, 2013 and 2015.
‡ Additional Energy Balance indicators are applicable to the industrial sector categories but not included here as no data reported for Belgium (excluded indicators are: B_101314 - Gas Works; B_101316 - Coal Liquefaction Plants; B_101317 - Liquefaction (LNG) / regasification plants; B_101319 - Gas-to-liquids (GTL) plants (energy))
^ Additional E-PRTR activities are applicable to the industrial sector categories but not included here as no data reported for Belgium (excluded activities include: gasification and liquefaction (1b), coke ovens (1c)]; Mineral [Other (3f-g)]; Waste management Other activities [Intensive rearing of poultry and pigs (7a); Production of carbon (9d)]

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

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

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - power																	
SO_x	kt	63.00	61.18	55.31	55.14	57.74	50.95	45.87	38.03	25.82	14.07	13.01	11.87	9.46	7.97	6.92	6.91
NO_x	kt	78.08	71.33	66.49	69.03	70.23	64.26	58.74	54.59	43.82	33.41	33.22	28.49	26.13	23.28	25.39	26.47
$PM_{2.5}$	kt	2.77	2.38	2.85	2.21	2.48	2.19	2.05	2.22	1.69	1.42	1.23	1.41	1.20	1.31	1.11	1.18
NMVOC	kt	2.14	2.29	2.64	2.62	2.50	2.54	2.17	2.14	2.02	1.62	2.14	1.79	1.53	1.74	1.66	1.72
NH_3	kt	0.39	0.26	0.32	0.31	0.33	0.35	0.45	0.41	0.29	0.28	0.35	0.80	0.35	0.62	0.42	0.35
Cd (HM)	t	0.36	0.27	0.31	0.34	0.39	0.31	0.34	0.34	0.53	0.35	0.41	0.41	0.36	0.34	0.31	0.32
As (HM)	t	0.79	0.79	0.79	0.76	0.69	0.80	0.53	0.72	0.73	0.64	0.67	0.55	0.56	0.49	0.42	0.59
Cr (HM)	t	2.60	1.37	1.33	1.77	3.07	2.33	1.80	2.80	2.80	2.50	2.83	3.43	3.22	2.00	1.79	2.02
Cu (HM)	t	1.57	1.57	1.58	1.37	1.42	1.96	1.01	1.01	1.25	1.22	1.64	1.49	0.98	0.98	0.96	1.10
Pb (HM)	t	4.49	4.07	4.49	4.34	5.02	4.57	3.96	5.14	5.07	4.71	3.54	3.64	3.36	3.08	3.01	3.27
Hg (HM)	t	0.73	0.67	1.49	1.47	1.14	0.35	0.37	0.44	0.59	0.41	0.48	0.57	0.32	0.35	0.46	0.35
Ni (HM)	t	8.69	11.00	18.46	9.63	11.64	10.56	10.20	6.25	4.04	2.53	2.92	3.77	3.26	1.67	1.32	1.80
Zn (HM)	t	22.55	23.02	18.64	12.74	9.09	8.75	8.76	8.73	8.83	8.80	11.03	12.56	11.97	11.87	11.79	12.95
PCDD+PCDF	g	11.07	12.23	1.77	2.73	1.49	1.75	3.21	6.14	15.55	3.67	2.64	1.53	1.72	1.68	1.60	2.05

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - refining, coke																	
SO_x	kt	25.61	24.67	23.76	25.41	26.29	24.80	24.42	23.02	20.81	21.22	10.09	9.17	8.73	6.78	7.32	8.38
NO_x	kt	10.10	10.20	9.66	9.73	10.36	11.16	9.21	8.76	6.63	5.51	5.67	5.03	5.48	5.21	5.08	5.05
$PM_{2.5}$	kt	1.00	0.88	0.77	0.68	0.72	0.56	0.83	0.49	0.18	0.19	0.05	0.03	0.05	0.04	0.02	0.0070
NMVOC	kt	1.39	1.43	1.33	1.33	1.35	1.41	1.40	1.33	0.75	0.48	0.48	0.45	0.52	0.51	0.45	0.36
NH_3	kt	0.0059	0.0062	0.0056	0.0055	0.0058	0.0065	0.0064	0.0062	0.0043	0.0092	0.0096	0.0092	0.02	0.01	0.0070	-
Cd (HM)	t	0.0080	0.0080	0.0045	0.0070	0.0059	0.0053	0.01	0.02	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.01
As (HM)	t	0.06	0.02	0.01	0.03	0.01	0.07	0.06	0.08	0.03	0.05	0.04	0.04	0.04	0.04	0.02	0.0062
Cr (HM)	t	0.58	0.48	0.50	0.49	0.47	0.09	0.10	0.34	0.06	0.07	0.09	0.09	0.09	0.08	0.07	0.05
Cu (HM)	t	0.09	0.07	0.13	0.11	0.11	0.09	0.02	0.08	0.04	0.06	0.08	0.08	0.08	0.08	0.06	0.04
Pb (HM)	t	0.09	0.03	0.04	0.05	0.05	0.03	0.12	0.16	0.07	0.08	0.10	0.09	0.13	0.12	0.08	0.03
Hg (HM)	t	0.01	0.0045	0.0018	0.02	0.0009	0.0058	0.0059	0.0078	0.02	0.02	0.02	0.02	0.03	0.03	0.01	0.0016
Ni (HM)	t	10.22	10.26	8.61	8.85	9.81	6.69	6.23	7.36	4.24	0.85	0.25	0.12	0.14	0.27	0.12	0.06
Zn (HM)	t	0.67	0.66	0.58	0.60	0.38	0.46	1.03	1.71	0.43	0.32	0.63	0.59	0.75	0.66	0.57	0.46
PCDD+PCDF	g	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.07	0.06	0.06	0.04	0.05	0.05	0.08	0.02
Metals: iron and steel																	
SO_x	kt	8.06	6.13	6.64	6.02	6.62	6.26	5.45	5.69	5.71	3.84	5.01	5.36	5.81	6.03	5.42	4.70
NO_x	kt	5.45	4.21	4.92	4.68	5.19	4.93	5.58	4.79	4.55	3.36	5.17	5.01	4.34	4.18	4.24	4.18
$PM_{2.5}$	kt	7.59	5.68	5.68	5.70	5.63	4.72	4.58	3.47	3.74	0.78	1.36	1.10	0.94	0.62	0.80	1.05
NMVOC	kt	1.41	1.23	1.11	1.33	1.59	1.79	1.49	1.19	2.13	1.14	1.47	0.95	1.32	1.07	1.68	0.60
NH_3	kt	-	-	0.05	0.05	0.06	0.06	0.06	0.10	0.14	0.05	0.03	0.07	0.03	0.05	0.02	0.05
Cd (HM)	t	1.16	0.86	0.86	0.87	1.19	0.71	0.93	0.80	0.91	0.33	0.57	0.46	0.23	0.22	0.18	0.50
As (HM)	t	1.15	1.05	1.11	1.10	1.15	0.99	1.03	1.41	1.60	0.44	0.54	0.46	0.28	0.17	0.16	0.16
Cr (HM)	t	11.70	11.51	11.39	11.20	11.20	10.65	12.69	13.41	12.87	4.03	6.64	4.78	4.82	1.34	1.56	1.30
Cu (HM)	t	5.45	4.60	4.35	4.13	4.88	3.61	3.84	3.47	4.59	1.33	2.24	2.05	1.45	0.83	1.13	0.91
Pb (HM)	t	76.38	54.30	55.20	53.99	63.38	52.44	53.42	42.02	55.02	15.59	22.90	16.28	17.34	14.38	12.76	17.79
Hg (HM)	t	0.58	0.45	0.75	0.59	0.61	0.68	0.61	1.61	1.88	0.19	0.40	0.26	0.16	0.11	0.20	0.11
Ni (HM)	t	6.71	6.48	5.63	5.13	4.71	3.73	4.34	4.54	4.25	1.63	2.46	2.05	0.90	0.94	1.24	0.98
Zn (HM)	t	80.32	75.28	87.04	87.91	127.17	59.63	59.77	69.60	64.91	30.52	39.08	33.16	6.58	7.53	11.83	8.25
PCDD+PCDF	g	55.63	16.24	11.92	14.23	18.42	15.52	13.62	10.33	11.86	5.76	6.31	7.45	11.16	3.87	4.28	5.07

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Metals: Non-ferrous																	
SOx	kt	3.90	3.92	3.52	3.58	4.02	3.28	2.82	3.46	3.10	1.23	1.93	2.13	2.42	2.48	3.03	2.89
NOx	kt	0.61	0.50	0.51	0.63	0.59	0.60	0.60	0.46	0.36	0.26	0.34	0.36	0.42	0.51	0.47	0.51
$PM_{2.5}$	kt	0.04	0.06	0.04	0.05	0.05	0.06	0.04	0.04	0.03	0.02	0.02	0.03	0.02	0.01	0.02	0.03
NMVOC	kt	0.70	0.67	0.65	0.66	0.70	0.65	0.77	0.55	0.37	0.20	0.21	0.27	0.22	0.27	0.24	0.23
NH_3	t	13.71	13.24	1.34	0.30	0.56	0.30	0.68	1.17	0.29	0.29	0.06	-	-	-	-	0.24
Cd (HM)	t	0.33	0.43	0.28	0.29	0.24	0.31	0.16	0.16	0.14	0.10	0.09	0.11	0.11	0.10	0.11	0.15
As (HM)	t	1.26	1.57	1.33	1.08	0.97	0.92	1.12	1.44	0.69	0.69	0.48	0.49	0.55	0.51	0.39	0.43
Cr (HM)	t	0.05	0.06	0.15	0.38	0.47	0.51	0.46	0.29	0.26	0.25	0.68	0.52	0.10	0.04	0.03	0.02
Cu (HM)	t	3.43	2.94	3.10	2.64	1.72	1.60	1.31	0.82	0.66	0.64	0.53	0.54	0.86	0.77	0.71	0.88
Pb (HM)	t	10.81	10.33	10.18	8.85	8.84	9.73	4.40	4.81	2.84	2.38	2.63	2.61	2.06	2.18	2.24	2.97
Hg (HM)	t	0.14	0.14	0.14	0.16	0.18	0.11	0.12	0.11	0.11	0.04	0.06	0.06	0.06	0.05	0.03	0.03
Ni (HM)	t	0.06	0.08	0.13	0.21	0.21	0.17	0.35	0.35	0.11	0.10	0.15	0.21	0.26	0.16	0.16	0.10
Zn (HM)	t	36.32	31.95	30.52	26.43	22.66	21.16	19.31	12.43	13.47	4.82	11.88	15.17	27.27	17.32	16.96	19.17
PCDD/F	g	1.27	0.47	0.75	0.41	0.18	0.52	0.21	0.28	0.21	0.35	0.27	0.30	0.30	0.27	0.21	0.21
Mineral: Cement, lime and magnesium oxide																	
SO_x	kt	10.82	10.00	11.09	11.15	7.94	8.38	7.98	9.38	6.77	5.11	5.74	4.81	4.18	3.41	3.51	3.21
NO_x	kt	20.25	17.53	15.38	15.61	20.55	20.36	16.26	17.17	13.63	11.20	12.91	14.43	13.26	12.38	11.17	10.51
$PM_{2.5}$	kt	0.75	0.61	0.58	0.70	0.35	0.19	0.18	0.14	0.16	0.07	0.09	0.09	0.03	0.03	0.04	0.03
NMVOC	kt	0.94	0.93	1.06	0.97	0.57	1.07	1.12	1.07	0.68	0.48	0.35	0.29	0.35	0.52	0.27	0.45
NH_3	kt	0.27	0.25	0.17	0.27	0.34	0.30	0.32	0.29	0.34	0.34	0.35	0.40	0.45	0.30	0.29	0.31
Cd (HM)	t	0.06	0.05	0.05	0.05	0.07	0.03	0.04	0.03	0.02	0.01	0.0078	0.01	0.01	0.02	0.02	0.0071
As (HM)	t	0.14	0.13	0.11	0.09	0.09	0.08	0.09	0.06	0.05	0.06	0.08	0.06	0.04	0.12	0.11	0.06
Cr (HM)	t	0.46	0.42	0.47	0.73	0.35	0.50	0.78	0.25	0.23	0.72	0.40	0.26	0.29	0.18	0.20	0.14
Cu (HM)	t	0.33	0.41	0.30	0.59	0.31	0.31	0.42	0.17	0.11	0.06	0.12	0.21	0.14	0.10	0.19	0.14
Pb (HM)	t	1.58	1.46	0.84	1.13	0.66	0.71	1.63	1.27	0.75	0.22	2.51	0.32	0.35	0.23	0.29	0.12
Hg (HM)	t	0.35	0.33	0.40	0.45	0.59	0.27	0.27	0.44	0.49	0.57	0.29	0.31	0.28	0.28	0.32	0.22
Ni (HM)	t	0.54	0.50	0.61	0.75	0.28	0.27	0.26	0.17	0.11	0.09	0.14	0.15	0.22	0.22	0.19	0.14
Zn (HM)	t	3.22	3.43	1.74	1.81	0.99	1.38	2.70	1.04	0.78	0.64	1.09	1.28	0.60	0.71	0.92	0.92
PCDD+PCDF	g	0.64	0.60	0.30	0.55	0.55	0.78	0.55	0.73	0.60	0.51	0.44	0.25	0.26	0.27	0.40	0.81

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Mineral: Other																	
SO_x	kt	11.05	11.01	10.00	8.41	11.25	9.00	9.27	8.86	8.02	5.39	3.17	2.79	1.70	1.66	2.35	2.25
NO_x	kt	0.86	0.94	1.07	0.71	0.35	0.38	0.48	0.43	0.27	0.33	0.28	0.29	0.17	0.14	0.14	0.18
$PM_{2.5}$	kt	0.98	0.96	1.01	0.95	0.78	0.60	0.60	0.61	0.54	0.50	0.48	0.54	0.45	0.37	0.44	0.44
NMVOC	kt	2.86	3.14	2.83	2.56	1.85	1.59	1.61	1.24	1.17	1.04	1.05	0.97	0.68	0.71	0.73	0.66
Cd (HM)	t	0.05	0.05	0.05	0.05	0.09	0.09	0.10	0.10	0.10	0.08	0.09	0.05	0.06	0.06	0.07	0.06
As (HM)	t	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Cr (HM)	t	0.02	0.04	0.02	0.08	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.03
Cu (HM)	t	-	-	0.0018	-	-	-	0.0042	-	-	-	-	0.0011	0.0011	0.0018	0.0004	0.0018
Pb (HM)	t	0.12	0.17	0.33	0.15	0.21	0.21	0.20	0.32	0.31	0.26	0.28	0.16	0.12	0.17	0.20	0.19
Hg (HM)	t	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Ni (HM)	t	0.0022	0.16	0.0031	0.09	0.01	0.04	0.10	0.0028	0.0026	0.02	0.0054	0.03	0.0029	0.0020	0.0039	0.0078
Zn (HM)	t	0.0002	0.03	0.0062	0.04	0.02	0.07	0.0086	-	0.04	-	0.0001	0.0092	0.0054	0.04	0.0059	0.05
PCDD+PCDF	g	0.59	0.58	0.58	0.56	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.04	0.04	0.05	0.05
Chemical																	
SO_x	kt	7.90	7.16	7.60	4.96	4.81	5.44	4.75	6.10	4.66	2.67	3.67	3.38	2.52	2.52	2.39	2.59
NO_x	kt	9.60	10.13	9.18	7.12	7.60	8.38	7.96	8.14	7.07	5.79	6.96	7.01	6.47	6.75	6.89	7.61
$PM_{2.5}$	kt	0.27	0.29	0.26	0.30	0.35	0.29	0.23	0.23	0.22	0.20	0.30	0.27	0.24	0.26	0.23	0.21
NMVOC	kt	14.86	14.26	14.95	12.96	13.60	13.34	13.81	13.36	12.53	11.79	11.71	10.34	10.35	9.72	9.35	9.12
NH_3	kt	1.12	0.91	0.84	0.84	0.94	0.78	0.85	1.03	0.85	0.63	0.75	0.86	0.99	0.99	0.89	1.02
Cd (HM)	t	0.0012	0.0012	0.0007	0.0075	0.0075	0.0075	0.0030	0.0045	0.0074	0.0044	0.0050	0.0076	0.0061	0.0047	0.0028	0.0071
As (HM)	t	-	-	-	-	-	-	-	-	-	-	-	0.0003	0.0009	0.0009	0.0003	0.0020
Cr (HM)	t	0.04	0.04	0.04	-	-	-	-	-	-	-	-	0.05	0.0019	0.0054	0.0017	0.0065
Cu (HM)	t	0.0067	0.0062	0.09	0.10	0.09	0.29	0.21	0.08	0.13	0.04	0.31	0.09	0.03	0.03	0.04	0.09
Pb (HM)	t	0.21	0.21	0.25	0.22	0.30	0.21	0.17	0.19	0.19	0.10	0.11	0.13	0.04	0.13	0.12	0.75
Hg (HM)	t	0.68	0.50	0.35	0.31	0.35	0.27	0.29	0.22	0.22	0.22	0.20	0.21	0.19	0.30	0.27	0.18
Ni (HM)	t	0.75	0.64	0.59	0.39	0.77	0.86	0.68	0.80	0.89	0.33	0.46	0.54	0.14	0.18	0.23	0.08
Zn (HM)	t	0.56	0.56	0.56	0.76	0.67	0.45	0.60	0.44	0.56	0.46	0.60	0.33	0.42	0.45	0.37	0.23
PCDD+PCDF	g	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.06	0.03	0.08	0.12	0.06	0.10	0.14

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste: hazardous																	
SO_x	kt	1.06	1.07	1.17	1.11	1.22	1.29	1.24	1.14	1.31	1.03	0.0032	0.0035	0.0018	0.0009	0.0022	0.0019
NO_x	kt	0.12	0.13	0.17	0.19	0.25	0.27	0.19	0.12	0.41	0.52	0.57	0.51	0.49	0.39	0.19	0.20
$PM_{2.5}$	kt	0.0005	0.0003	0.0003	0.0007	0.0002	0.0006	0.0006	0.0004	0.0005	0.0019	0.0064	0.0043	0.0031	0.0011	0.0011	0.0009
NMVOC	kt	0.04	0.03	0.05	0.12	0.09	0.08	0.08	0.20	0.27	0.17	0.16	0.17	0.17	0.15	0.16	0.18
NH_3	kt	-	-	-	-	0.03	-	-	-	-	-	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002
Cd (HM)	t	0.0004	0.0001	-	-	0.0005	0.0004	0.0001	0.00	0.0009	0.0008	0.0010	0.0009	0.00	-	-	-
As (HM)	t	-	-	-	-	0.0008	0.0024	0.0002	0.00	0.0023	0.0015	0.0019	0.0019	0.0001	-	-	-
Cr (HM)	t	0.0003	0.0035	-	-	0.0100	0.0035	0.0006	0.00	0.0006	0.0028	0.0059	0.0034	0.00	-	-	-
Cu (HM)	t	0.0064	0.0029	-	-	0.0011	0.0010	0.0002	0.00	0.0023	0.0015	0.0019	0.0019	0.0001	-	-	-
Pb (HM)	t	0.0068	0.0023	-	0.00	0.0021	0.0010	0.0000	0.00	0.0023	0.0012	0.0051	0.0019	0.00	-	-	-
Hg (HM)	t	0.0027	0.0032	-	-	0.0007	0.0020	0.0002	0.00	0.0002	0.0020	0.0043	0.0010	0.00	-	-	-
Ni (HM)	t	0.0010	0.0008	-	-	0.0008	0.0029	0.0003	0.0009	0.0023	0.0012	0.0007	0.0019	0.02	0.01	0.01	0.01
Zn (HM)	t	-	-	-	-	0.0004	0.0004	0.0002	0.0005	0.0004	0.0005	0.0005	0.0005	0.0005	-	-	-
PCDD+PCDF	g	1.84	2.05	0.23	0.24	0.20	0.17	0.17	0.15	0.05	0.06	0.08	0.21	0.19	0.19	0.18	0.52
Waste: non-hazardous																	
SO_x	kt	0.04	0.02	0.03	0.04	0.07	0.07	0.08	0.04	0.10	0.03	0.0040	0.0077	0.0045	0.02	0.0043	0.0038
NO_x	kt	0.41	0.35	0.33	0.16	0.27	0.11	0.03	0.03	0.02	0.04	0.04	0.03	0.03	0.10	0.03	0.03
$PM_{2.5}$	kt	0.02	0.02	0.02	0.02	0.01	0.0025	0.0012	0.0009	0.0010	0.0013	0.0009	0.0009	0.0010	0.0023	0.0011	0.0013
NMVOC	kt	2.54	2.27	2.16	1.84	1.83	1.63	1.58	1.47	1.36	1.30	1.17	1.14	1.09	1.00	0.93	0.81
NH_3	kt	0.08	0.06	0.07	0.09	0.09	0.10	0.11	0.12	0.12	0.16	0.19	0.21	0.19	0.16	0.14	0.17
Cd (HM)	t	0.0076	0.0057	0.02	0.0085	0.01	0.0045	0.0011	0.0015	0.02	0.0042	0.0012	0.0009	0.0007	0.0092	0.0015	0.0014
As (HM)	t	0.06	0.07	0.04	0.02	0.03	0.02	0.0021	0.0033	0.0018	0.0060	0.0036	0.0020	0.0019	0.0095	0.0022	0.0043
Cr (HM)	t	0.03	0.06	0.16	0.03	0.04	0.05	0.0046	0.0098	0.0022	0.02	0.0072	0.01	0.0035	0.02	0.0043	0.0050
Cu (HM)	t	0.14	0.09	0.06	0.08	0.09	0.02	0.0018	0.0034	0.0063	0.01	0.0048	0.0020	0.0048	0.02	0.0071	0.0064
Pb (HM)	t	0.25	0.14	0.20	0.13	0.16	0.02	0.0039	0.01	0.0021	0.0064	0.0027	0.0024	0.0026	0.01	0.0039	0.0028
Hg (HM)	t	0.06	0.07	0.06	0.04	0.04	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04
Ni (HM)	t	0.07	0.05	0.0070	0.01	0.01	0.02	0.0021	0.0054	0.0091	0.0067	0.0039	0.0020	0.0018	0.01	0.0033	0.0032
Zn (HM)	t	0.13	0.15	0.15	0.25	0.25	0.05	0.04	0.04	0.03	0.07	0.04	0.03	0.03	0.07	0.02	0.03
PCDD+PCDF	g	0.27	0.36	0.13	0.16	0.18	0.01	0.0030	0.0038	0.0032	0.01	0.0066	0.0043	0.0041	0.0096	0.0054	0.0069

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Other activities																	
SO_x	kt	0.27	0.18	0.22	0.10	0.05	0.05	0.18	0.09	0.11	0.03	0.08	0.0054	0.03	0.0079	0.01	0.02
NO_x	kt	0.74	0.99	1.04	0.82	0.89	0.60	0.53	0.48	0.74	0.82	1.00	0.82	0.76	0.90	0.91	0.62
$PM_{2.5}$	kt	0.95	0.89	0.91	0.87	0.85	0.86	0.85	0.81	0.75	0.77	0.82	0.77	0.80	0.86	0.88	0.88
NMVOC	kt	77.27	79.12	72.82	68.45	63.54	62.36	62.92	57.22	53.23	45.33	44.32	41.74	39.17	36.19	35.41	34.06
NH_3	kt	19.79	19.20	18.82	18.27	17.84	17.53	17.42	17.14	17.17	16.69	17.03	16.74	17.38	17.05	16.89	16.87
Cu (HM)	t	2.71	2.71	2.72	2.73	2.74	2.76	2.79	2.79	2.81	2.83	2.85	2.88	2.90	2.91	2.92	2.94
PCDD+PCDF	g	0.0023	0.0018	0.0018	0.0016	0.0022	0.0025	0.0026	0.0023	0.0021	0.0022	0.0026	0.0026	0.0025	0.0025	0.0023	0.0023

Ricardo
Energy & Environment

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

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

ee.ricardo.com