Industrial emissions policy country profile – Romania

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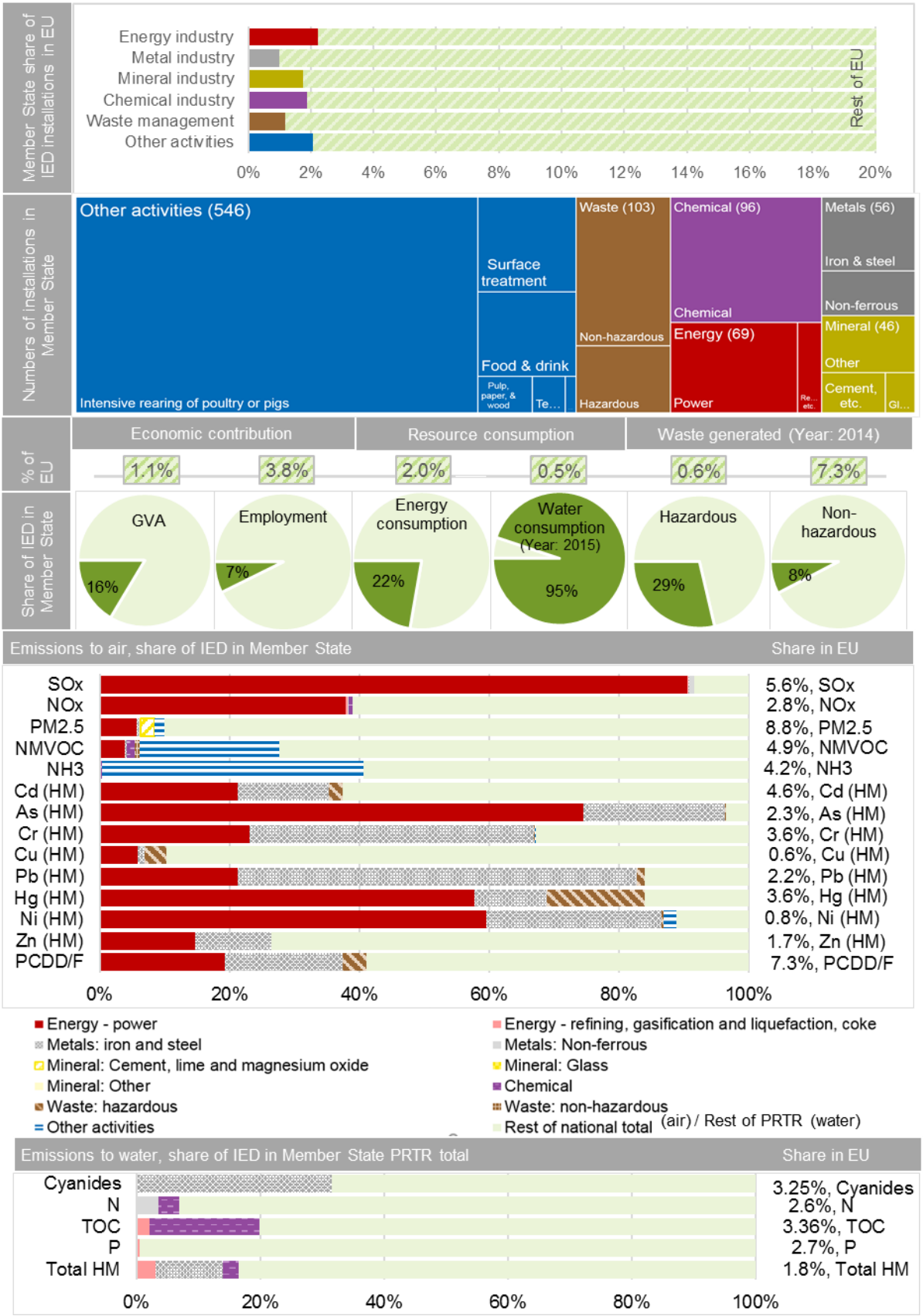
Abbreviations and units

AOX	Adsorbable Organic Halides
As	Arsenic
Cd	Cadmium
CLRTAP	Convention on Long-range Transboundary Air Pollution
CO_2	Carbon Dioxide
Cr	Chromium
Cu	Copper
DG	Directorate-General
EEA	European Environment Agency
E-PRTR	European Pollutant Release and Transfer Register
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 Romania



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 Romania.

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 Romania and how they have been addressed.

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

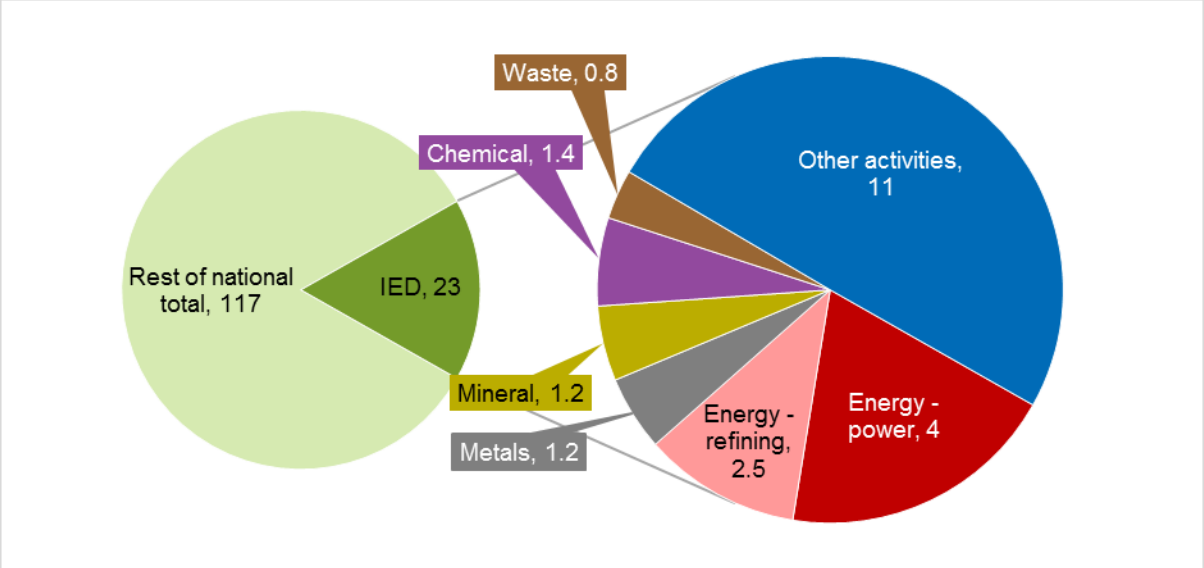
Gross value added (GVA) and employment are the indicators used to denote the economic contribution of IED activities.

Combined, the industrial sectors contribute a relatively small share of the total GVA across all economic activities in Romania (16%) (Figure 1)[1]. Of this share, 'other activities' and the energy - power sector account for the largest contribution (8% and 3% of the national total, respectively). Similarly, both sectors account for the largest employment within industry, although industry as a whole employs a smaller share of persons compared to the national total (with industry accounting for 7% of the national total, of which 'other activities' accounts for 4% and the energy – power sector 1%) (Figure 2).

Both the GVA and employment data for 'other activities' relates to food and drink products, textiles and pulp, paper, and wood-based products sectors. No GVA or employment data for intensive rearing of poultry and pigs could be included here for the reasons discussed in the accompanying methodology report. This represents a significant data gap for Romania as of the 546 IED permitted installations within 'other activities', the majority carry out intensive rearing of poultry or pigs (439) (section 2.2).

Although not included in the data presented here, the economic significance of intensive rearing of poultry or pigs to the national economy and the agricultural sector is expected to be important for Romania. The Farm Survey Statistics for 2010 (Eurostat, 2012) reported that agricultural land covered ~56% of the total land cover in Romania, and that the economic value of the sector as a whole (based on the average monetary value of the agricultural output) doubled between 2007 and 2010, making it comparable with values reported by the Netherlands and Denmark in 2010. Within the agricultural sector, livestock represents a key industry with the number of livestock units per hectare of agricultural land again comparable to densities reported by Denmark as well as Ireland (Eurostat, 2012)[2].

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



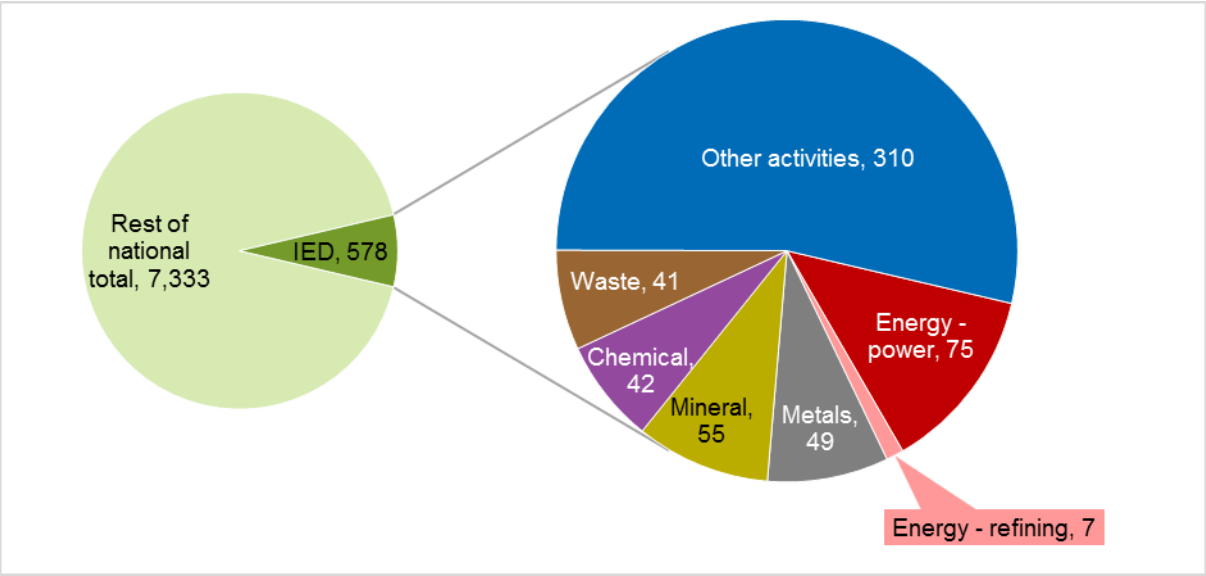
Note: Rest of national total means all NACE activities minus the industrial sectors shown here. The data shown for 'other activities' includes, among others, the subsectors of textiles and tanning [of leather products] which are reported together as one subtotal; so although no IED installations are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

Source: Eurostat (2017a)

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

[2] The agricultural census is updated every 10 years and the next update will be reported in 2022.

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



Note: Rest of national total means all NACE activities minus industrial sectors shown here. Data for tanning activities within 'other activities' excluded as not operational under the IED in Romania.

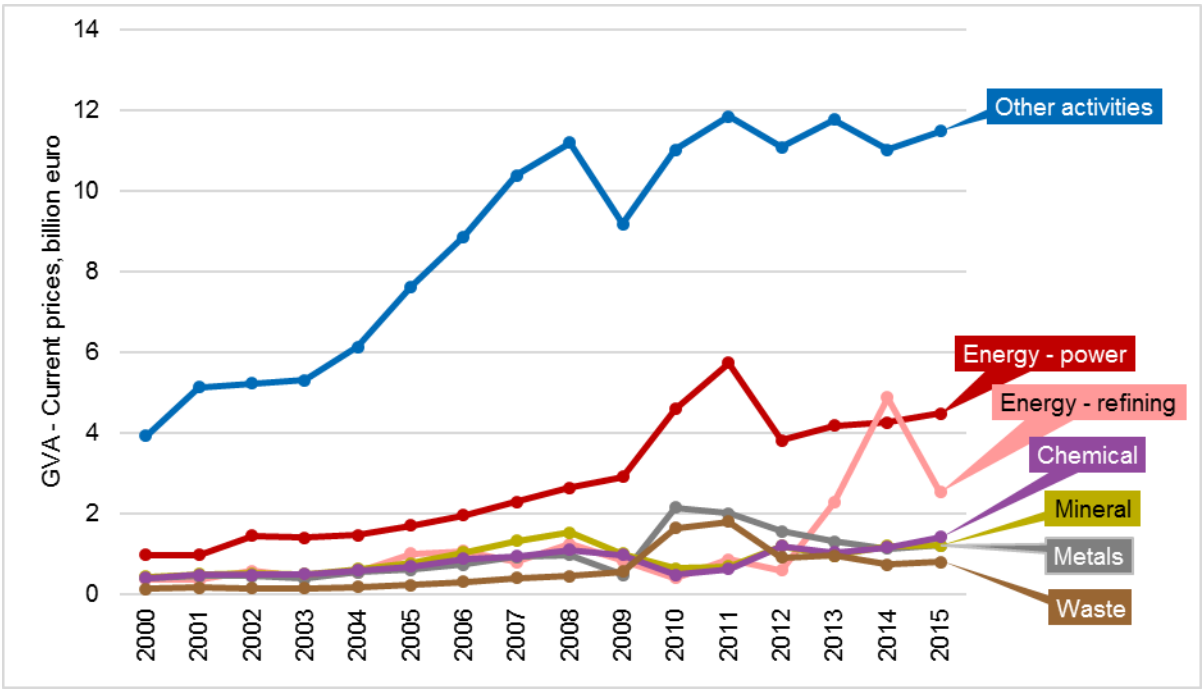
Source: Eurostat (2017b)

The main industrial sectors with economic growth in Romania, as measured by absolute growth in GVA, are 'other activities' and energy - power (Figure 3). The most significant growth is apparent for the energy - power sector which grew by €3.5bn (equivalent to a factor of 4.6) between 2000 and 2015. The GVA for 'other activities' increased by €7.6bn (equivalent to a three-fold increase) in the period 2000 to 2015. In fact, all the industrial sectors at least tripled their GVA over the fifteen year period. The growth in 'other activities' is apparent across all sectors within 'other activities' except the manufacturing of wood-based products which grew by a factor of 1.5.

The timeseries for GVA indicates that certain industrial sectors in Romania contracted in 2009, presumably as a result of the economic crisis. Only the energy – power and waste management sectors reported GVA growth in this time, while a decline was reported for the energy – refining, metal, mineral and chemical sectors and 'other activities'. The GVA for the metal sector appears to have recovered by 2010 but GVA growth was slower to return for the other sectors, particularly for the energy – refining sector.

This apparent economic pressure on the industrial sectors in Romania is also reflected in the employment data for 'other activities'. Figure 4 shows that employment by the sector fell most noticeably between 2008 and 2010. Overall, between 2008 and 2015 there is a slight downward trend in employment by industry in Romania which contrasts with the growth in GVA.

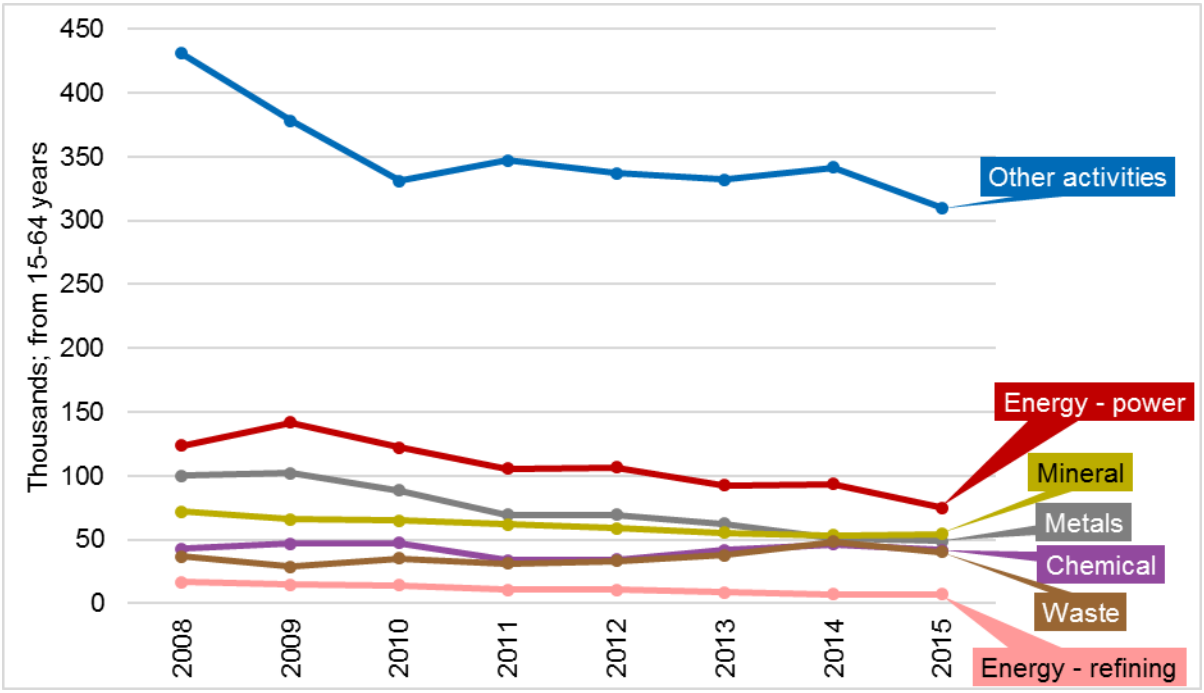
Figure 3: Gross value added of industrial sectors (2000-2015)



Note: Rest of national total means all NACE activities 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 GVA cannot be excluded for this activity.

Source: Eurostat (2017a)

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



Note: Rest of national total means all NACE activities minus industrial sectors shown here. Data for tanning within 'other activities' excluded as not operational under the IED in Romania.

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 Romania

Missing data	Description	Conclusion and actions taken
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 GVA cannot be excluded for this activity.	No action

2.2 Number of IED installations

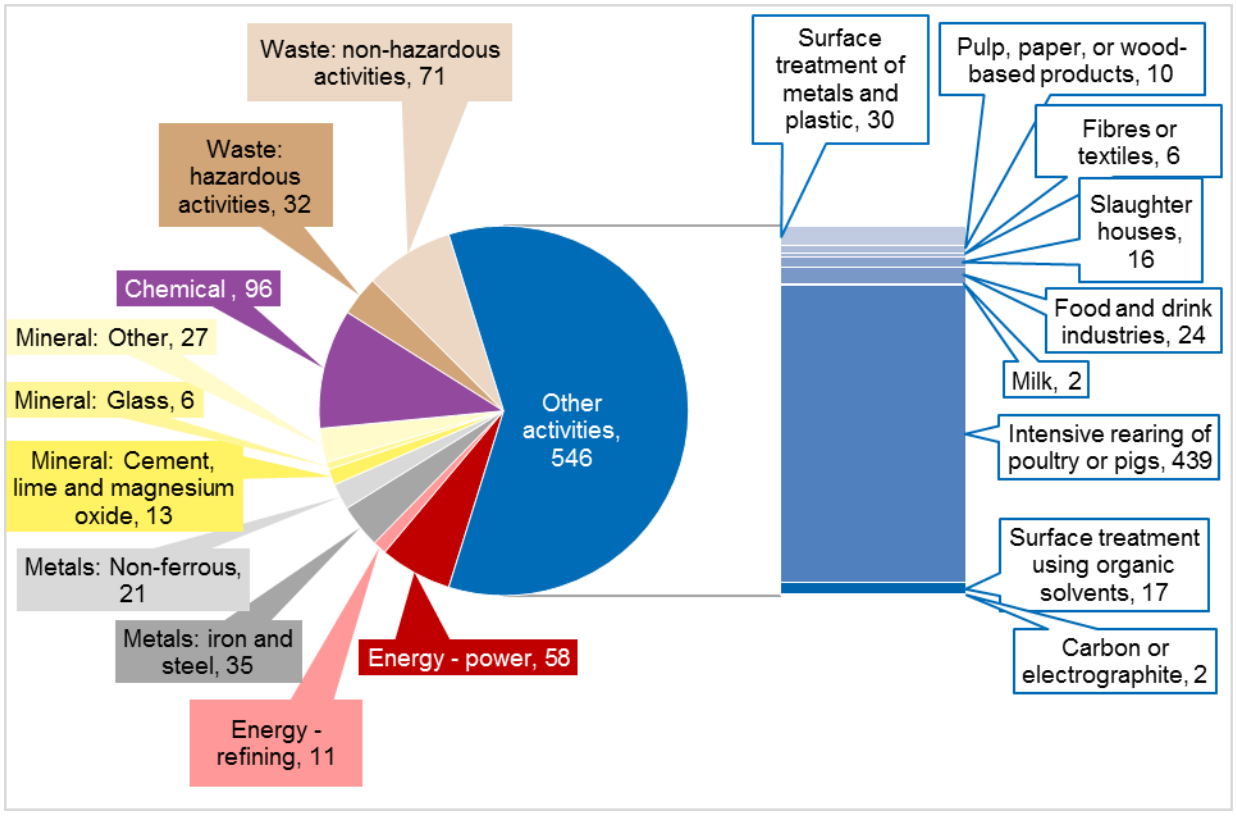
The main industrial sector in Romania, according to the reported number of permitted IED installations reported, is intensive rearing of poultry or pigs, comprising 48% of total IED installations in 2015 (Figure 5, Table 3). This is followed by the waste management (11%) and chemical (10%) sectors (MMEDIU, 2017a).

According to this same dataset, there are many IED installations permitted in Romania, across most IED activities. No IED installations were reported as permitted for coke production (IED activity 1.3), gasification and liquefaction (IED activity 1.4), metal ore production (IED activity 2.1), mineral fibre production (IED activity 3.4), underground storage of hazardous waste (IED activity 5.6) and tanning (IED activity 6.3).

It should be noted that different sources are used to compare the number of installations reported in 2011 and 2015. For 2015, a national dataset was provided by the Ministry of Environment (MMEDIU, 2017a). It reports a greater number of permitted installations compared to the dataset provided by the European Commission. The main differences between the datasets reported are for the waste management sector (both hazardous and non-hazardous) and by 'other activities' (with 30 and 56 additional installations reported, respectively).

The national dataset also includes reporting on the annual production by IED activity, the number of environmental permits issued and the number of updated permits reported for 2015. The annual production data is sector specific and has not been included in this profile owing to the additional context needed to determine the significance of productions levels. The number of environmental permits issued by industrial sector is similar to the reported number of installations permitted. It is not possible to compare the two directly as environmental permits can relate to parts of an installation. In broad terms, 904 environmental permits were reported for the year 2015 (12 less than the number of total installations permitted), and 127 environmental permits were reported as being in process, which together with the existing permits, results in an additional 115 environmental permits compared to the total number of reported installations permitted (Ministry of Environment (MMEDIU), 2017a). Environmental permits are set in accordance with the BAT conclusions, and the BAT reference documents where no conclusions have been published. No examples of stricter permit conditions were reported by Romania in the previous round of implementation reporting (Amec Foster Wheeler, 2016b).

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



Note: Data for intensive rearing of poultry or pigs is grouped together here owing to the level of granularity available in the national dataset.

Source: MMEDIU (2017a)

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

Industrial sector, with IED activity detail	2011 [1]	2015 [2]	Change in number of IED installations 2011 to 2015
Energy: power *(1.1 Combustion)*	**55**	**58**	**3**
Energy: refining, gasification and liquefaction, coke *(1.2 Refining)*	**7**	**11**	**4**
Metals: iron and steel	**37**	**35**	**-2**
2.2 Iron or steel	*12*	*10*	*-2*
2.3 Processing ferrous metals	*15*	*19*	*4*
2.4 Ferrous metals foundries	*10*	*6*	*-4*
Metals: Non-ferrous *(2.5 Processing non-ferrous metals)*	**20**	**21**	**1**
Mineral: Cement, lime and magnesium oxide *(3.1)*	**13**	**13**	**0**
Mineral: Glass *(3.3 Manufacture of glass including glass fibre)*	**4**	**6**	**2**
Mineral: Other *(3.5 Manufacture of ceramic products)*	**24**	**27**	**3**
Chemical	**70**	**96**	**26**
4.1 Organic chemicals	*39*	*58*	*19*
4.2 Inorganic chemicals	*15*	*19*	*4*
4.3 Phosphorus-, nitrogen- or potassium-based fertilisers	*4*	*6*	*2*
4.4 Plant protection products	*1*	*0*	*-1*
4.5 Pharmaceutical products	*5*	*6*	*1*
4.6 Explosives	*6*	*7*	*1*
Waste: hazardous	**15**	**32**	**17**
5.1 Disposal / recovery	*15*	*28*	*13*
5.5 Temporary storage	*0*	*4*	*4*
Waste: non-hazardous	**49**	**71**	**22**
5.2 Non-hazardous co-/incineration	*0*	*7*	*7*
5.3 Other non-hazardous	*0*	*3*	*3*
5.4 Landfills	*43*	*51*	*8*
6.5 Disposal of animal carcases	*6*	*9*	*3*
6.11 Independently operated treatment of waste water	*-*	*1*	*1*
Other activities	**433**	**546**	**113**
6.1 Pulp, paper, or wood-based products	*7*	*10*	*3*
6.2 Textiles	*6*	*6*	*0*
6.7 Surface treatment using organic solvents	*15*	*17*	*2*
2.6 Surface treatment of metals and plastic	*27*	*30*	*3*
6.4 (a) Slaughterhouses	*14*	*16*	*2*
6.4 (b) Food and drink	*17*	*24*	*7*
6.4 (c) Milk	*2*	*2*	*0*
6.6 Intensive rearing of poultry or pigs	*343*	*439*	*96*
6.8 Carbon or electrographite	*2*	*2*	*0*
Total	**727**	**916**	**189**

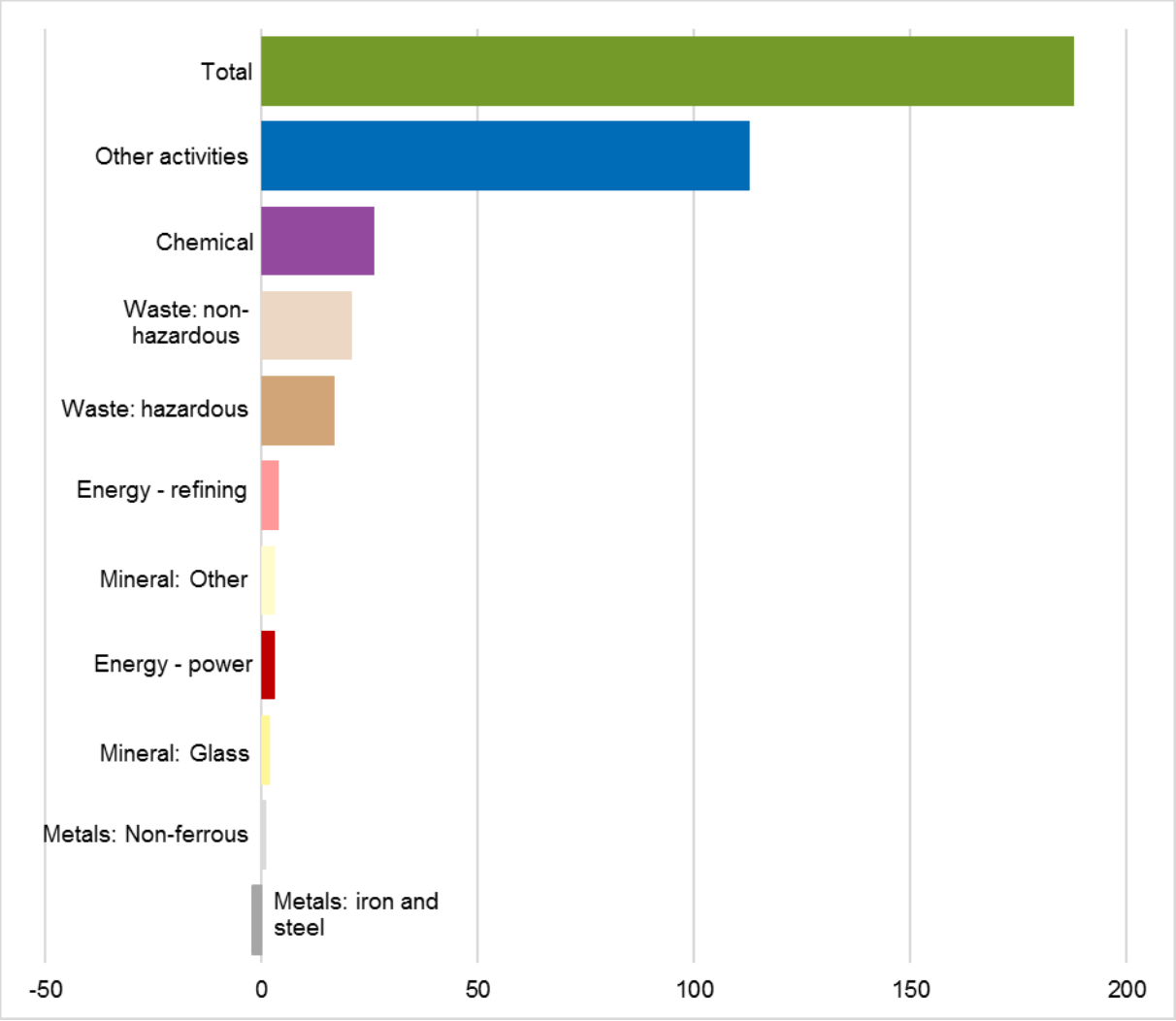
Note: IED activities are in italics. The IED activity 5.2 (Disposal or recovery of waste in waste incineration plants or in waste co-incineration plants) relates to non-hazardous waste (5.2(a)) and hazardous waste (5.2(b)). Owing to the generally small number of installations reported within this category across the EU, these installations have been categorised as non-hazardous waste management. Data for permitted installations carrying out IED activity 6.11 was not included among the regulated activities of the IPPCD and therefore the difference reported between 2011 and 2015 may be either owing to an additional installation or changes in the scope of legislation. Data for intensive rearing of poultry or pigs is grouped together here owing to the level of granularity available in the national dataset. No IED installations were permitted for the following IED activities comprising industrial sectors: Energy: gasification and liquefaction, coke (IED activities 1.3-1.4); Iron and steel – ore roasting and sintering (IED activity 2.1); Mineral fibres (IED activity 3.4); Waste management (IED activities 5.6); and within 'other activities (IED activity 6.3).

Source: [1] IPPCD / DG Environment, [2] MMEDIU (2017a)

Between 2011 and 2015, there was an increase in the reported number of permitted IED installations in Romania (comparing IPPCD installations to IED installations in this timeframe) (Figure 6). This increase occurred most significantly within 'other activities' owing to increased installations reported for intensive rearing of poultry or pigs.

It should be noted that the national dataset used for 2015 includes a larger number of permitted installations compared to the dataset provided by the European Commission (916 compared to 838), and that the largest difference noted affects the intensive rearing of poultry or pigs. This suggests that part of this difference could be a discrepancy in reporting (whereby 439 installations are reported by the national authorities compared to 392 by the European Commission).

Figure 6: Change in number of installations per industrial sector 2011[1] to 2015[2]



Notes: No changes reported for cement, lime and magnesium production; removed from the chart.

Source: [1] IPPCD / DG Environment, [2] MMEDIU (2017a)

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. Further, limitations apply to the EU dataset used for Romania in light of the inconsistency with the national dataset – as described above in the narrative.

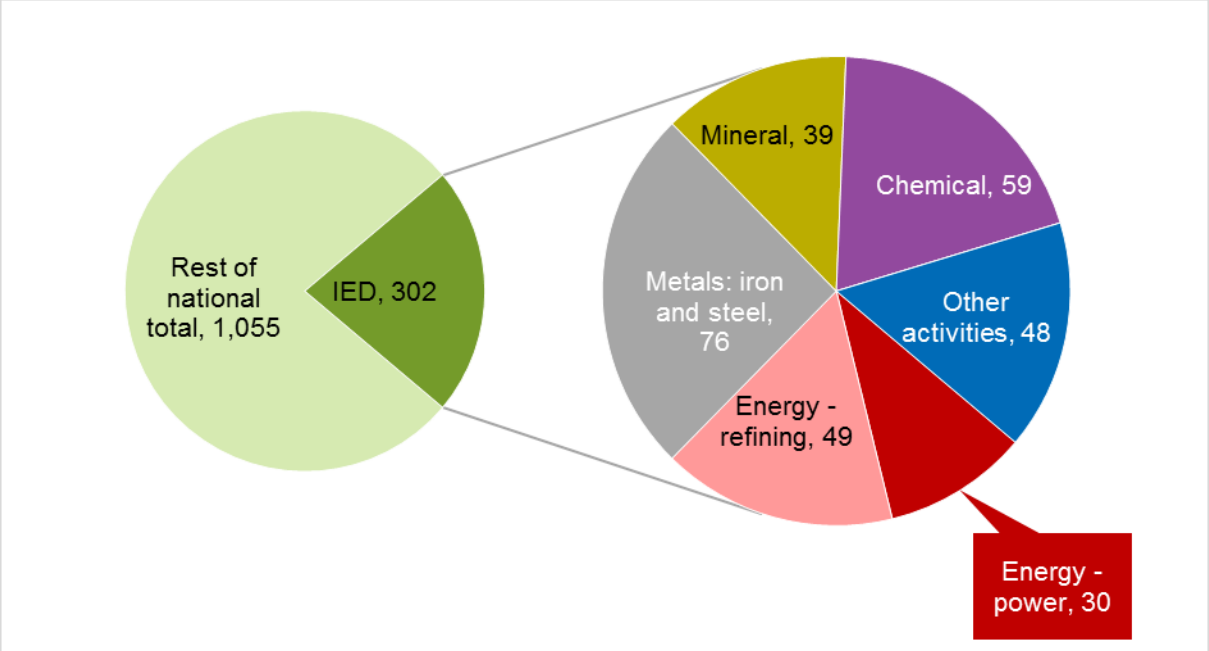
3 Resource use in industrial sectors

3.1 Energy consumption

The energy consumed by the industrial sectors in Romania accounts for almost a quarter of the total reported energy consumption in the country in 2015 (22%) (Figure 7). The energy consumed is fairly evenly split between sectors in 2015 although the production of iron and steel can be seen to account for the largest share (25% of the energy consumed by industry).

Note that no data was reported for the non-ferrous metal and waste management industrial sectors (as explained in Table 4). The lack of energy consumption data for the intensive rearing of poultry or pigs within 'other activities' is not considered a particular data gap despite the large number of IED installations permitted for this sector. This is because the agriculture sector as a whole does not consume a great deal of energy according to the national agri-environmental indicator for the sector which shows that in 2014 the sector consumes 1.9% of the total energy consumed in Romania (Eurostat, 2016).

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



Note: Rest of national total relates to gross inland consumption minus industrial sectors shown here. No data for the non-ferrous metal and waste management 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, energy consumption cannot be excluded for this activity.

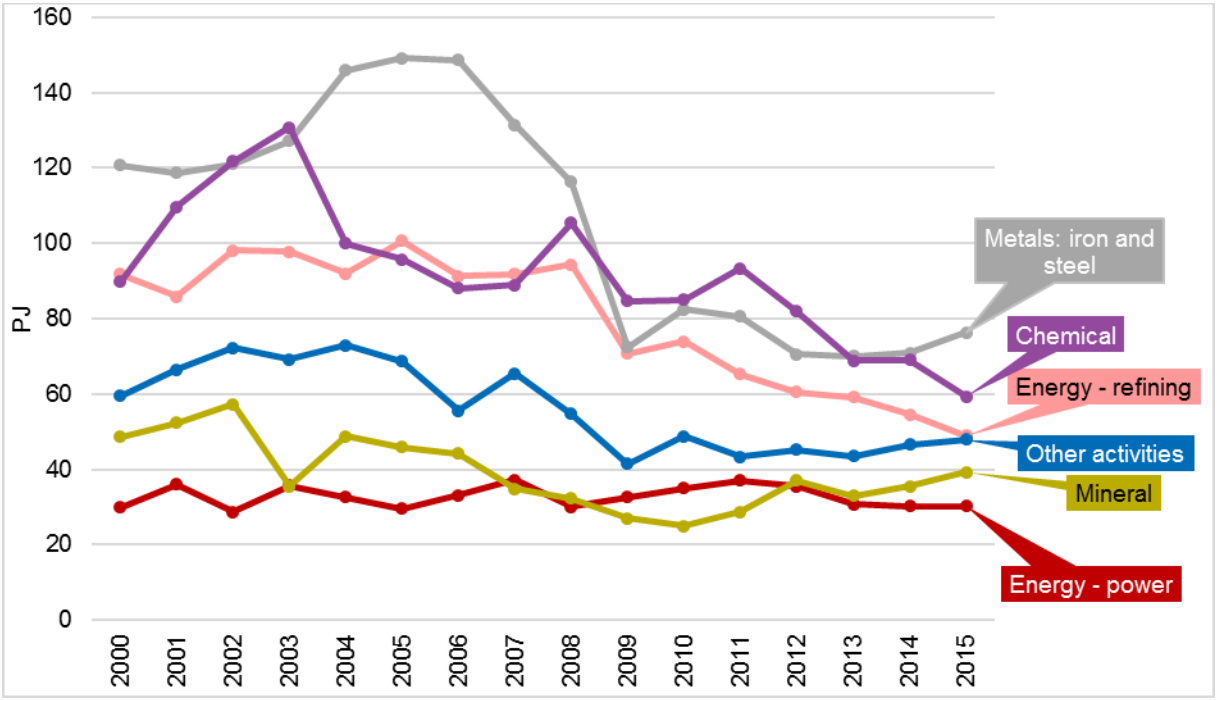
Source: Eurostat (2017c)

The time series in Figure 8 shows that energy consumption across industrial sectors has generally decreased steadily over time (this trend applies to all sectors except for energy – power which fluctuated). At the same time, all the industrial sectors more than tripled their GVA over the fifteen year period (section 2.1). This indicates that there has been a degree of decoupling from energy consumption and economic growth achieved by industrial sectors in Romania.

Despite this evidence of decoupling, the energy consumption trends shown in Figure 8 suggest that industry in Romania is sensitive to wider economic pressures. A dip is evident in 2009 for energy consumed by the iron and steel, chemical and energy-refining sectors as well as for 'other activities'. Together with the trends identified in section 2.1, it could be inferred that this dip in energy consumption occurred as a result of reduced production owing to economic pressures. The sector where this trend is most exaggerated is the production of iron and steel, in which energy consumption levels halved between 2006 and 2009 and remained comparatively level thereafter. Although the GVA recovered

quickly from the economic crisis, employment by the sector fell as did production (Romania Trade and Invest, 2011).

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



Note: No data for the non-ferrous metal and waste management 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, energy consumption 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 has only limited coverage of the waste management sector. Data for this sector is therefore expected to be underreported as only one energy balance indicator was identified as relevant to this industrial sector: the energy consumed by gasification plants for biogas. Thus, where no data for the waste management sector is identified, 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 Romania

Missing data	Description	Conclusion and actions
No data for waste management	No data reported for all waste management – limitation of dataset.	No action
Data gap	No data reported for non-ferrous metal production.	No further information available from the competent authority.
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, energy consumption cannot be excluded for this activity.	No action

3.2 Water consumption

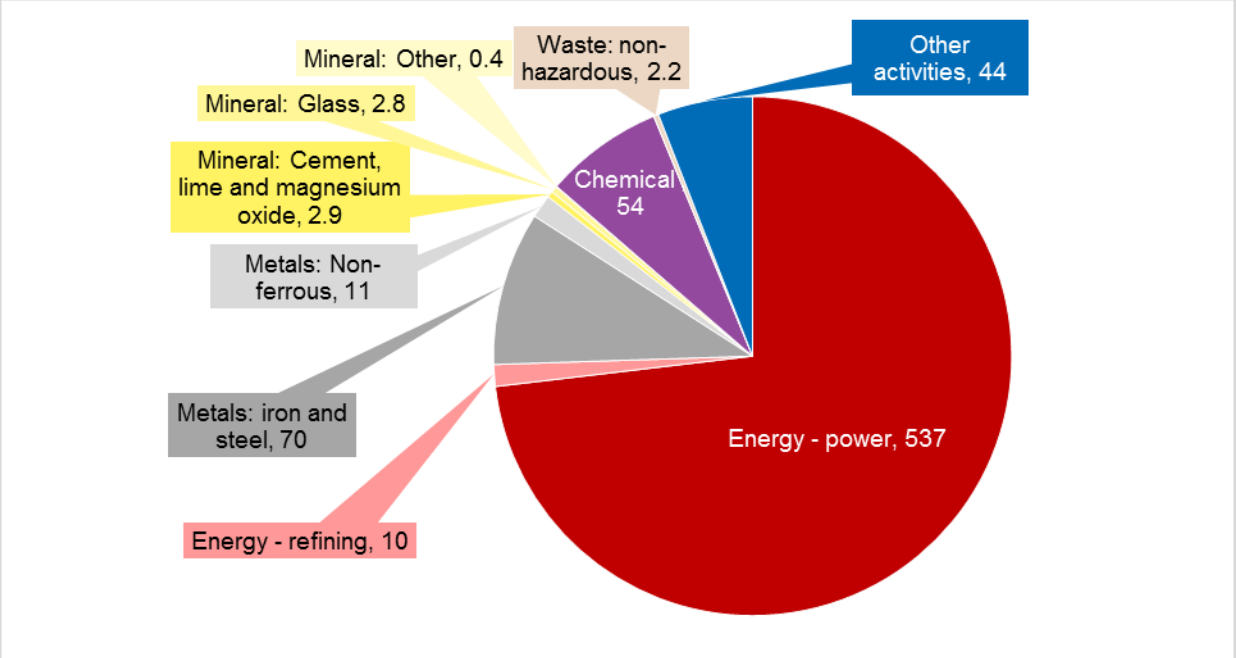
National data was provided by the MMEDIU to show water consumption and water reuse by the industrial sectors in Romania (MMEDIU, 2017b) (Figure 9). In comparison to the water consumption data reported to Eurostat, the industrial sectors in Romania uses a significant share of the national total (accounting for 95% of water use in 2015) (Eurostat, 2017d). However, the Eurostat dataset is incomplete for Romania and only includes water use from public supply (and not from self and other supply) and the same dataset indicates that water use by the industrial sector accounts for just a quarter of the national total. Owing to this inconsistency between the two datasets the national dataset for industry is not presented as a proportion of the national total.

Figure 9 indicates that among industry, the energy - power sector consumed the greatest share of water (accounting for 73% of the industry total). Other sectors of significance include the metal (mainly iron and steel production) and chemical sectors and 'other activities'.

Within 'other activities', intensive rearing of poultry or pigs consumed the greatest share of water (18 million m^3; accounting for 41% of the water consumed within 'other activities'), following by the food and drink sector (15 million m^3; accounting for 35% of the water consumed within 'other activities').

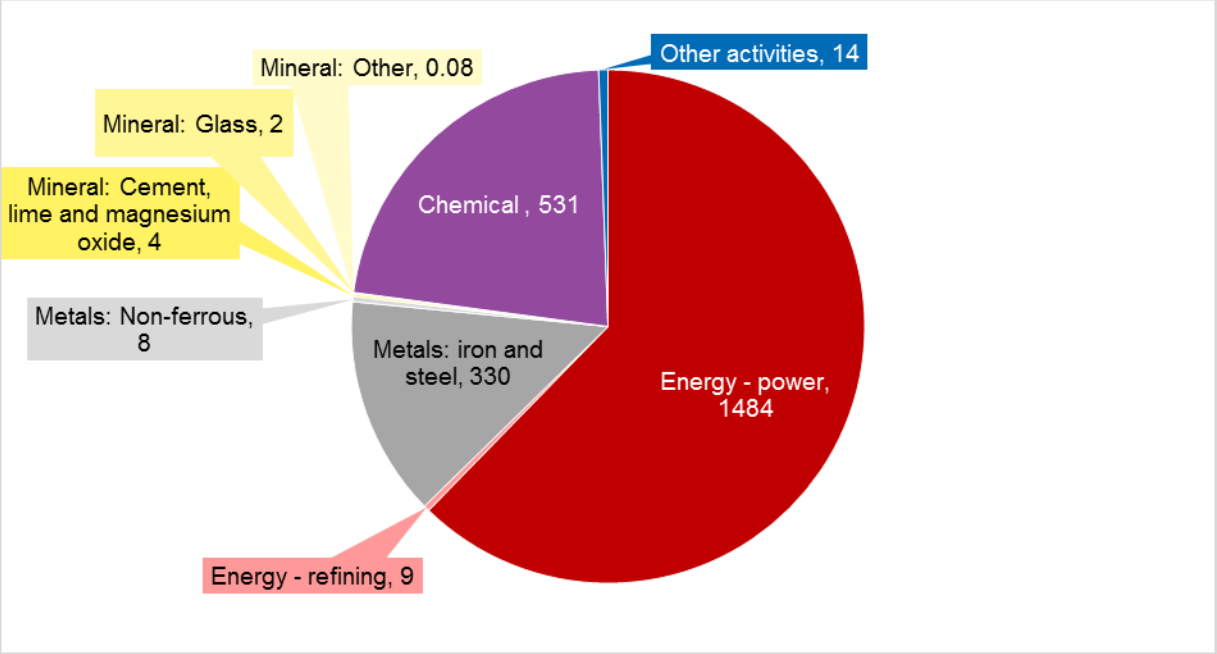
Water reuse is most prominent among the energy - power, iron and steel and chemical sectors; the sectors consuming the greatest volumes of water (Figure 10). It is understood that without water reuse, the volume of water consumed by these sectors (as presented in Figure 9) would be considerably greater.

Figure 9: Water consumption (million m^3) (2015)



Source: MMEDIU (2017b)

Figure 10: Water reuse (million m^3) (2015)



Source: MMEDIU (2017b)

Limitations

The water use data is reported by IED activity and provided by the Romanian competent authorities MMEDIU (2017b), as such no limitations have occurred from the mapping to IED activities. A discrepancy between this national dataset and the dataset reported by Eurostat is observed and the water consumed by industry is not presented as a proportion of the national total for Romania.

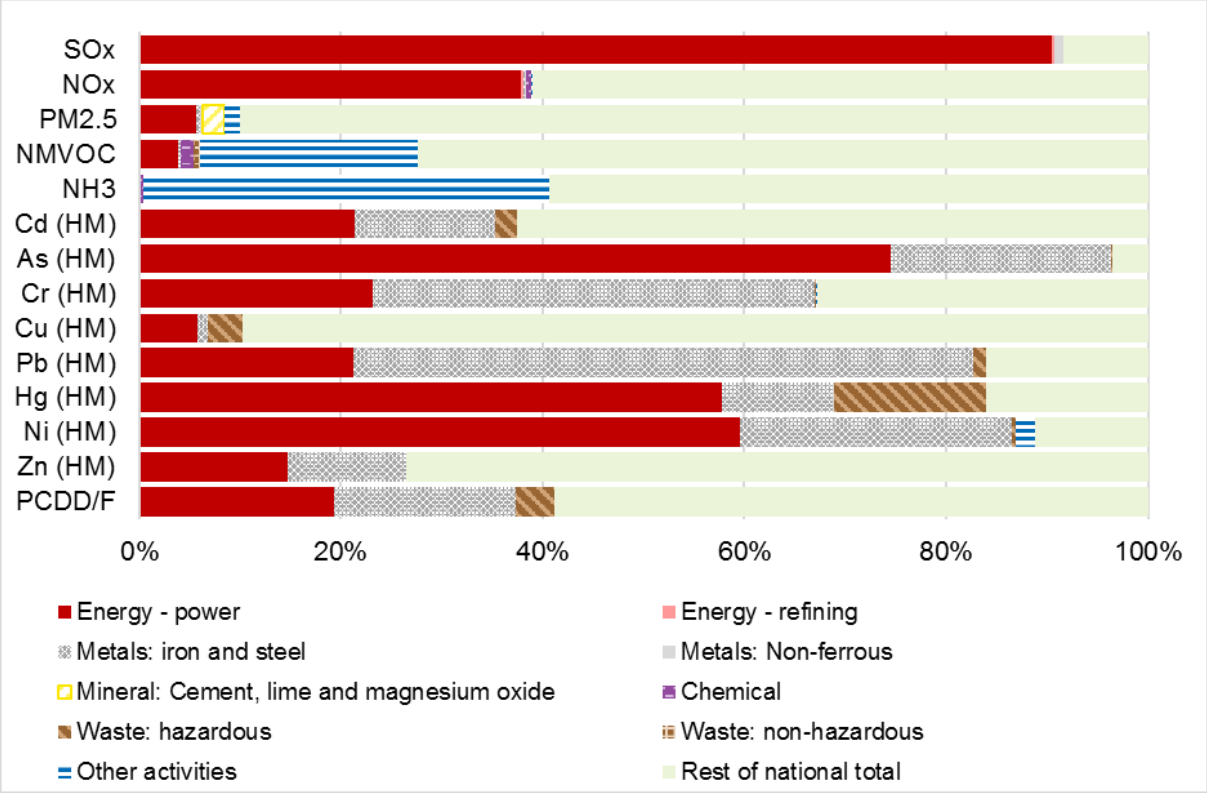
4 Emissions from industrial sectors

4.1 Emissions to air

Two data sources were used. First, data spanning the period 2000 to 2015, taken from inventories submitted by Romania under the CLRTAP (EEA, 2017a) (Figure 11). The second data source only covers the year 2015, taken from national reporting for industries regulated by the IED and does not show IED emissions relative to the rest of the national total (MMEDIU, 2017c) (Figure 13).

Relative to national emissions, reporting under CLRTAP shows that industrial sectors are responsible for a significant share of the emissions of SO_x, As, Cr, Pb, Hg, Ni, emitting over half the emissions to air for these pollutants. Among the industrial sectors, the energy-power sector is responsible for the greatest share of emissions to air of SO_x, NO_x, $PM_{2.5}$, Cd, As, Cu, Hg, Ni, Zn, PCCD/F (Figure 11). For Cr and Pb, the iron and steel sector is the main source. For both NMVOC and NH_3, the main industrial sector source is 'other activities'. Industrial sector NMVOC emissions primarily can be attributed to surface treatment and NH_3 to intensive rearing of poultry or pigs.

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



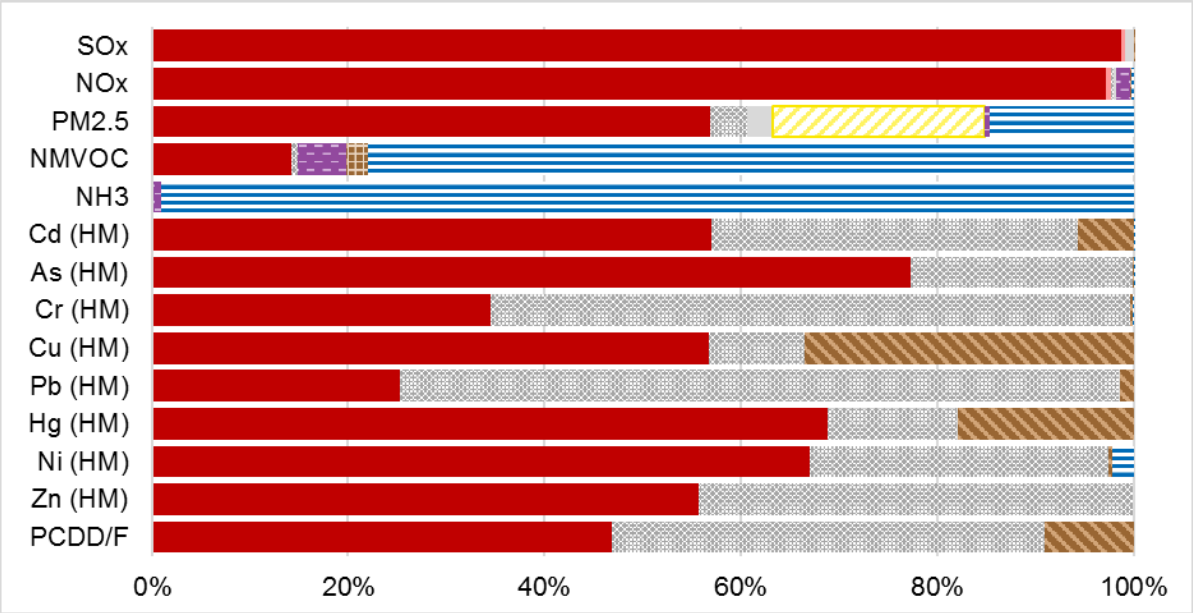
Note: Rest of national total relates to the national total for the entire territory (based on fuel sold) minus the industrial sector emissions shown here.

Source: EEA (2017a)

Relative to emissions by industrial sectors only, both datasets show that the energy – power sector is a key source of SO_x and NO_x and that 'other activities' emits the greatest share of NH_3 and NMVOC. However, the CLRTAP data shows that emissions to air of heavy metals and PCDD/F from hazardous waste management are more significant. The discrepancy between the two datasets is likely caused by differences in reporting, whereby hazardous waste from an industrial process is disposed of on site and the associated emissions are grouped under the respective industry. For example, national reporting shows that the production of cement, lime and magnesium oxide is a key source of several heavy metal pollutants, particularly Hg, Cr and Cu (Figure 13), whereas hazardous waste management is responsible for a considerable share of Hg and Cu according to CLRTAP reporting (Figure 12). Similarly, the greater proportion of emissions by the metal sector under national reporting is most likely to be owing to fact that emissions from blast furnaces within the iron and steel sector are grouped within energy – power under CLRTAP but not for the national reporting.

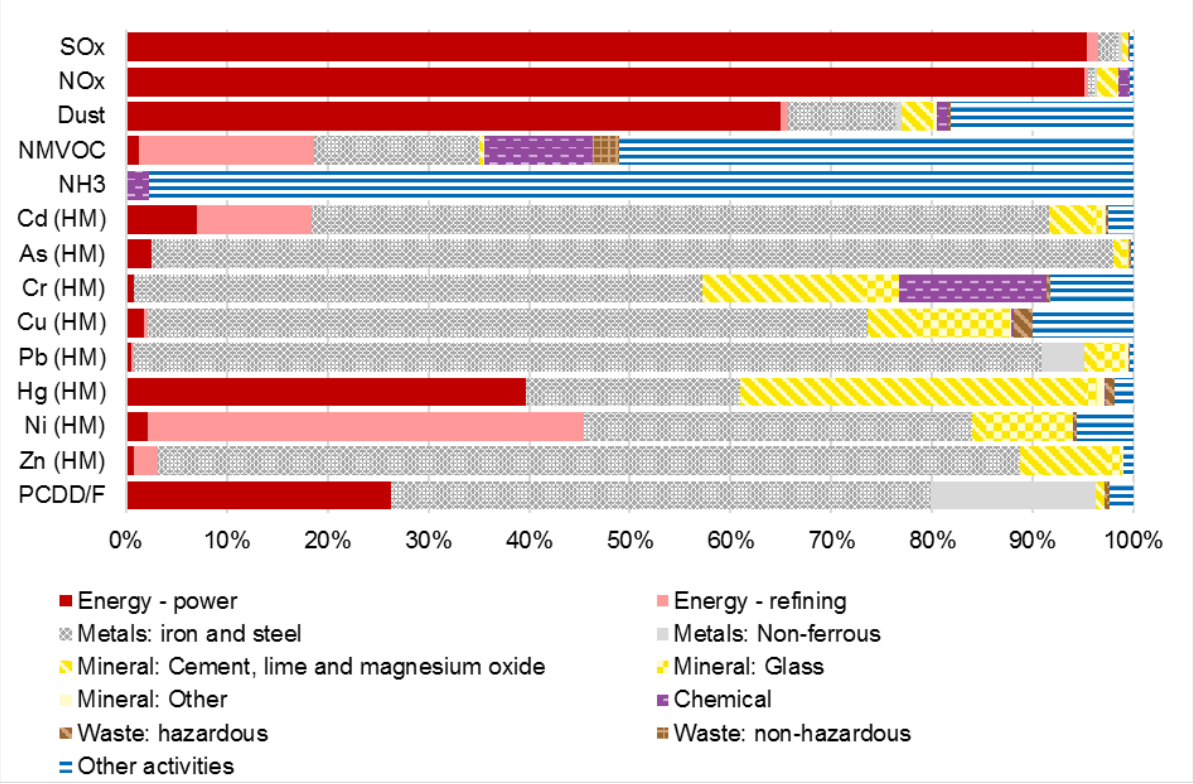
Another discrepancy between the two datasets concerns the energy -refining sector, which according to the national dataset is a key source of emissions to air of NMVOC and Ni. The quantity of the emissions reported for 2015 for the respective pollutants from the energy-refining sector is considerably greater in the national dataset compared to CLRTAP (1,824 t compared to 3.6 t for NMVOC and 245 kg compared to 0.9 g for Ni). Lastly, it is observed that the CLRTAP dataset does not report emissions for other mineral production; however, when compared to the national dataset, this lack of reporting is identified as a minor gap.

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



Note: The key for this chart is shown in Figure 11.
Source: EEA (2017a)

Figure 13: National reporting of emissions to air from industrial sectors (2015)



Source: MMEDIU (2017c)

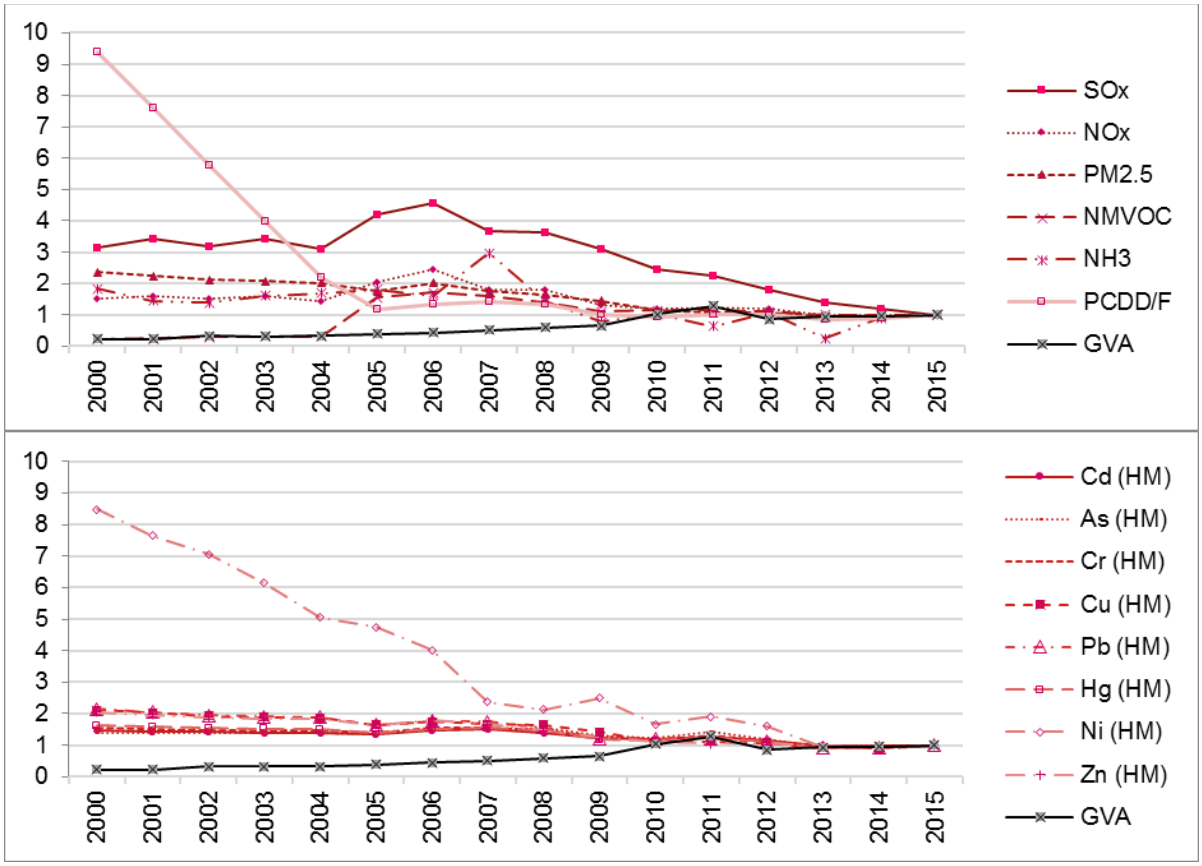
In the following subsections, emissions data are shown in indexed charts by sector. This was done to compare the development of pollutant emissions with the GVA in specific sectors in the period 2000 to 2015. The analysis has been undertaken using the CLRTAP dataset only as the dataset provided by the Romanian authorities only reports emissions for 2015. Emissions to air from many pollutants across all industrial sectors have decreased over time, while GVA has grown. Appendix 2 includes full details on the emissions reported by industrial sector and year.

Energy industry

All emissions from the energy – power sector decreased between 2000 and 2015. The most significant decreases reported for the energy – power sector relate to emissions of PCDD/F and Ni (between 2000 and 2007) (Figure 14). For PCDD/F, the trend shows that decreases slowed down after 2004 and annual emissions became more constant thereafter. The linear trend reported between 2000 and 2004 for PCDD/F is indicative of likely estimated emissions data rather than monitored data.

Figure 14 also shows a significant decreasing trend for SO_x emissions. The steady decline in SO_x emissions seen from 2006 to 2015 is in a time of growth in GVA together with increased energy and water consumption by the sector, indicating that emissions for the sector appear to have been decoupled from GVA. The reductions in SO_x are expected to emanate from compliance with the Large Combustion Plant Directive under which Romania had phased ceilings to comply with as part of the Accession Treaty. While the evidence presented here indicates that GVA growth for the sector is decoupled from emissions to air, there are some examples reported where failure to comply with the emission limit values has led to the closure of installations (CEE, 2015).

Figure 14: Indexed emissions to air from the energy - power industrial sector (indexed to 2015=1)



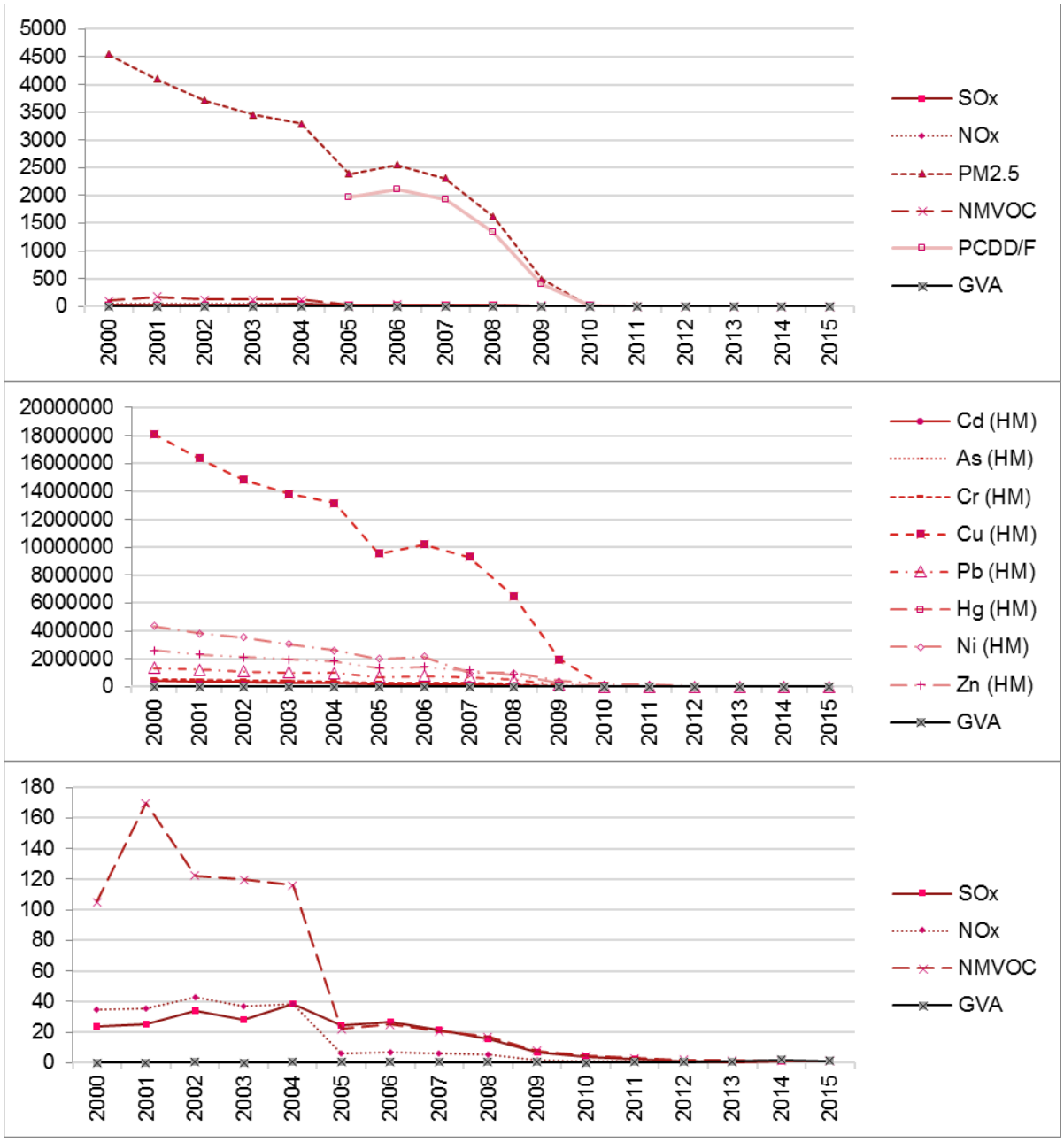
Source: EEA (2017a), Eurostat (2017a)

Emissions to air from the energy-refining sector have also decreased over time (Figure 15). The GVA for the sector has grown since 2012, with a spike in 2014 (not visible in Figure 15 but shown in Figure 3) and the number of permitted installations grew from 7 to 11 between 2011 and 2015. However, even with this growth, emissions remain in a downward trend. This trend appears particularly significant for $PM_{2.5}$, PCDD/F, and all heavy metals as the quantity of emissions fall close to zero by 2015.

In terms of quantities, emissions have decreased so significantly in this time for all pollutants that they are negligible compared to the emissions reported by other sectors (see Appendix 2). NH_3 emissions are not indexed in the chart below as reporting stopped in 2010 (thereafter emissions are marked as not estimated, indicating that this is a data gap). Until 2008, the energy-refining sector was a key source of NH_3 emissions (emitting similar quantities of NH_3 as 'other activities'). However, reporting of this pollutant fell in 2009 until it was no longer estimated in 2011.

The quantity of emissions to air reported under CLRTAP is less than the national reporting of emissions to air from the energy-refining sector. The differences are greatest for NMVOC, Ni and Zn. According to the national reporting, as a proportion of emissions to air from all industrial sectors, emissions of NMVOC and Ni are the most prominent from the energy-refining sector. Emissions of both pollutants have steadily declined overtime according to reporting under CLRTAP.

Figure 15: Indexed emissions to air from the energy - refining industrial sector (indexed to 2015=1)



Notes: No emissions are reported for PCDD/F between 2000 and 2004 (zeros not plotted). $PM_{2.5}$ and PCDD/F are removed in the third chart as outliers to make the detail for other pollutants visible.
Source: EEA (2017a), Eurostat (2017a)

Metal industry

Emissions to air from the iron and steel industrial sector have decreased between 2000 and 2015 for all pollutants shown in Figure 17 except NMVOC which has increased in this time. In terms of quantities, NMVOC emissions are however relatively low. The dip observed in the GVA trend for the year 2009 is understood to be as a result of the economic crisis; and, as discussed in section 2.1, the metal sector appeared to make a quick recovery in Romania. As such, the dip in GVA is not thought to have affected production levels significantly.

According to the CLRTAP dataset, the most significant pollutants for the iron and steel sector in terms of quantities are PCDD/F, Pb and Zn. While the national reporting also indicates that the iron and steel sector is a key source of these pollutants, the quantity of pollutants emitted is reportedly much less (2.5 g compared to 32.5 g of PCDD/F; 4.8 t compared 24 t of Pb; and 8.7 t compared to 13.6 t of Zn). According to the CLRTAP dataset, emissions of PCDD/F have decreased slightly and the trend implies that little has been carried out by the installations to improve emissions through compliance with BAT. Emissions of Pb and Zn, together with other heavy metal pollutants, all show a downward trend since 2000, with particularly large reductions in emissions achieved between 2005 and 2009.

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

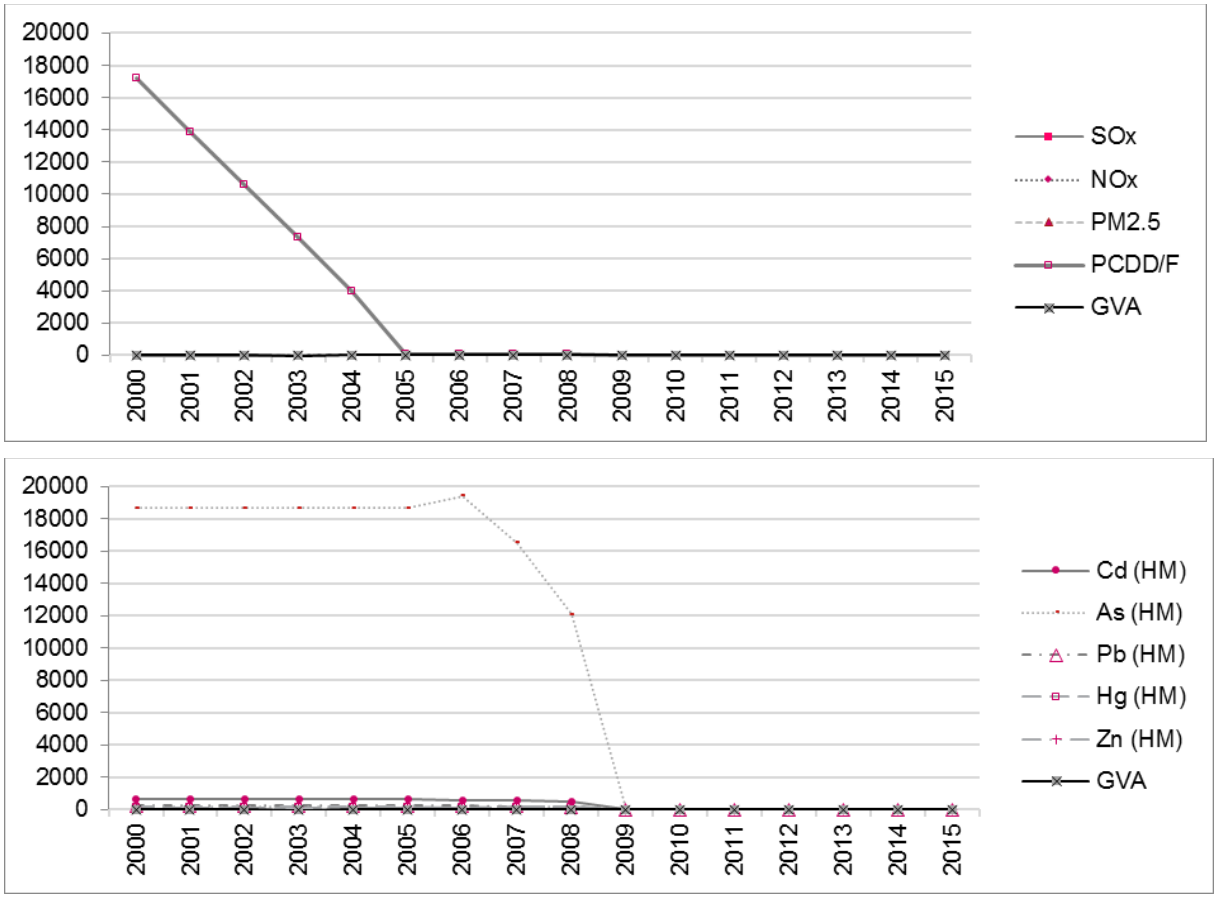
Notes: No reported emissions of NH_3. No emissions are reported for PCDD/F between 2000 and 2004. Values are not plotted to avoid misrepresenting the trend.

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

Emissions to air from the non-ferrous metals sector are shown in Figure 17. For all pollutants, emission levels are relatively low compared to other sectors in Romania in 2015. However, Figure 17 shows that historically, emission levels of PCDD/F and As were much higher (PCDD/F before 2005 and As before 2009); the quantities of these pollutants emitted in these earlier years was significant.

Figure 18 shows the emissions from this sector with the outliers of PCDD/F and As removed. The pollutant with the largest contribution for the non-ferrous metals sector in 2015 is $PM_{2.5}$. Emissions of $PM_{2.5}$ have declined relatively consistently since 2000. Emissions of SO_X have increased overall over 2000 to 2015; however, they have declined from a peak in 2008. SO_X emissions for this sector represent a small share of the national total in 2015 (Figure 12). Emissions of heavy metals have declined over time, consistently from 2010 to 2014, before small increases from 2014 to 2015 (this trend is more apparent in Figure 18 with the outliers removed).

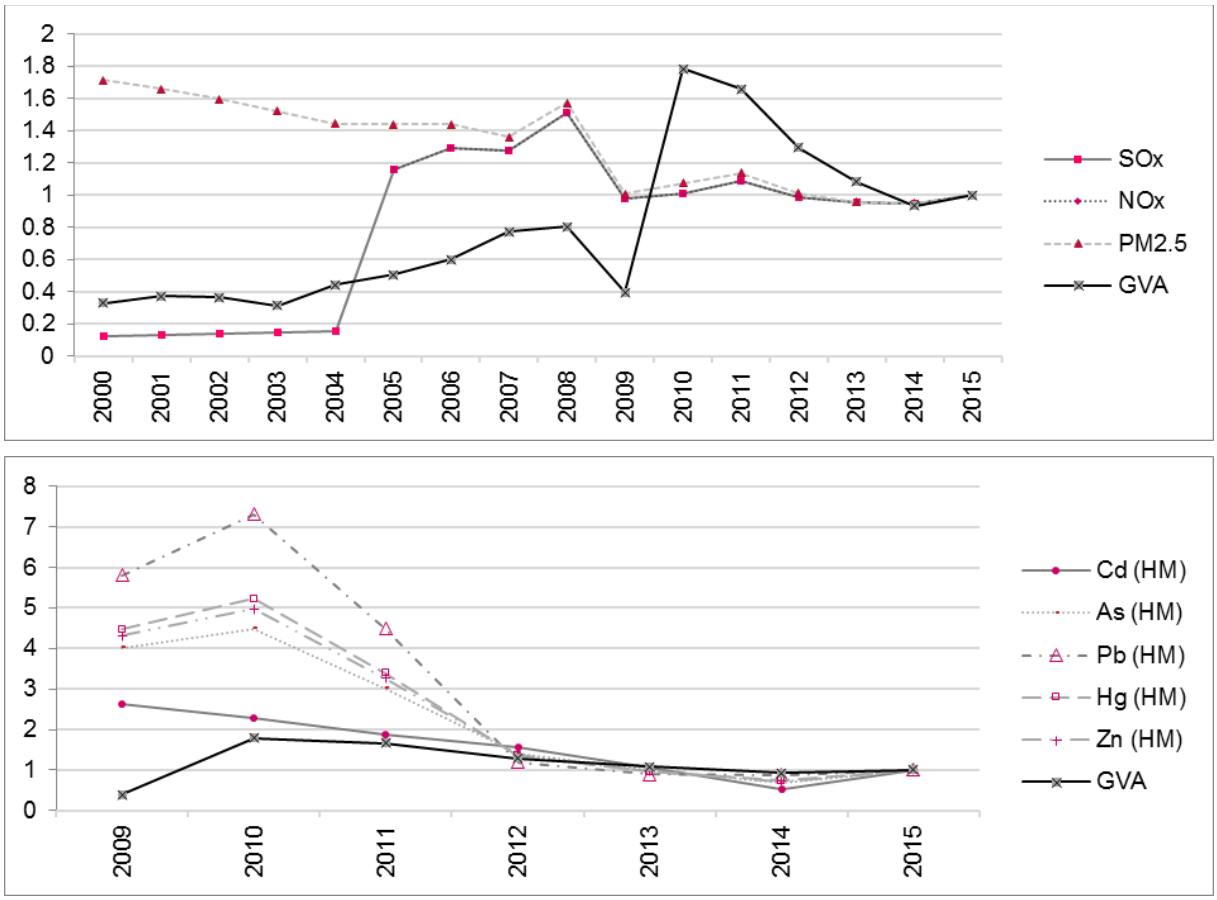
Figure 17: Indexed emissions to air from non-ferrous metals sector (indexed to 2015=1)



Note: No reported emissions of NH_3, NMVOC, Cr, Cu, and Ni. No emissions are reported for NO_x between 2000 and 2004. Values are not plotted to avoid misrepresenting the trends.

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

Figure 18: Indexed emissions to air from non-ferrous metals sector (indexed to 2015=1), with outliers removed



Note: PCDD/F has been removed from the first chart as an outlier to make the detail for the other pollutants visible. A reduced timeseries is used in the second chart to make the detail of the trends for heavy metals in more recent years visible. No reported emissions of NH_3, NMVOC. No reported emissions of Cr, Cu, and Ni in 2015 – not shown in this plot that is indexed to 2015. No emissions are reported for NO_x between 2000 and 2004. Values are not plotted to avoid misrepresenting the trends.

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

Mineral industry

Emissions to air from the mineral sector are only reported under CLRTAP from cement, lime and magnesium oxide production for $PM_{2.5}$ (Figure 19). The trend indicates that emissions have grown over time. According to the CLRTAP dataset, NH_3 emissions are occurring but have not been estimated, indicating that this is a data gap. For all other pollutants and industries within the mineral sector, emissions are reported as not applicable, indicating that there is no data gap.

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

Note: Only $PM_{2.5}$ emissions are reported. Emissions of NH_3 are marked as not estimated, meaning the lack of emissions data is a data gap. Other pollutants are marked as not applicable to the sector.

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

The national data however shows that the sector is responsible for the emission of several pollutants included in this profile (Table 5). While the quantity of emissions is greatest from cement, lime and magnesium production, Figure 13 indicates that emissions to air relative to other industrial sectors are particularly prominent from cement, lime, and magnesium oxide and glass production in Romania with respect to several heavy metal pollutants (notably, Cr, Cu, Hg, Ni and Zn). However, the lack of time series in the national dataset makes it impossible to establish a trend in the reported emissions. The emissions for other pollutants are minor relative to the national total.

Table 5: Emissions to air from the mineral industrial sector in 2015 (kg), national dataset

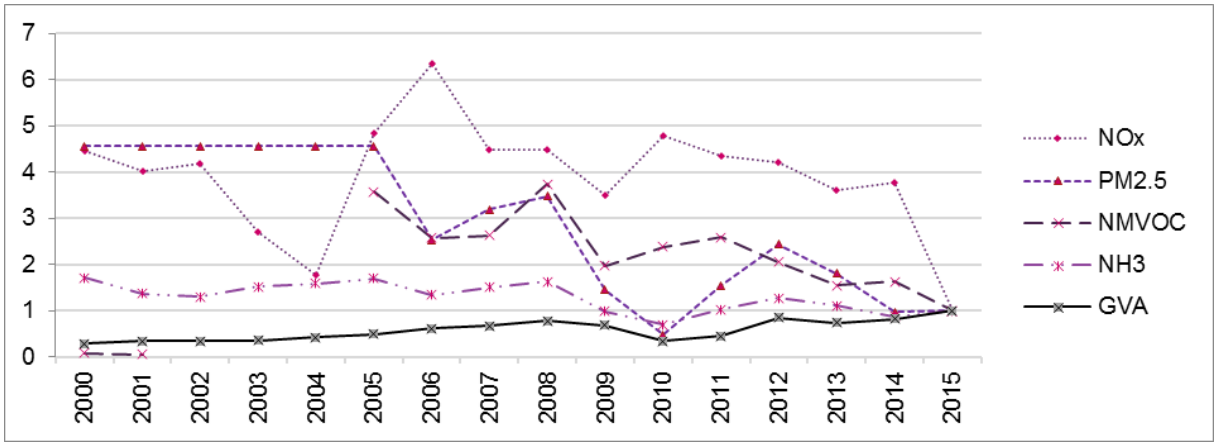
Pollutant	Mineral: Cement, lime and magnesium oxide	Mineral: Glass	Mineral: Other
SO_x	656,170	10,834	80,283
NO_x	7,867,457	475,560	417,497
Dust	306,418	-	37,679
NMVOC	28,906	-	18,166
NH_3	44,965	-	11
Cd (HM)	5	1	-
As (HM)	3	3	-
Cr (HM)	130	30	-
Cu (HM)	16	30	-
Pb (HM)	69	149	20
Hg (HM)	103	3	2
Ni (HM)	7	49	-
Zn (HM)	878	152	4
PCDD/F	40 mg	-	0.1 mg

Source: MMEDIU (2017c)

Chemical industry

Emissions to air from the chemical sector are shown in Figure 20. The trends indicate that emissions have decreased over time while GVA has grown. Furthermore, the quantity of emissions is comparatively low to emissions reported by other sectors (see detail in Appendix 2).

Figure 20: Indexed emissions to air from the chemical industrial sector (indexed to 2015=1)



Note: No PCDD/F or heavy metal emissions are reported 2000 to 2015. SOx emissions are only reported from ammonia production until 2004; from 2005 SO_x emissions from ammonia production are marked as not estimated, meaning the lack of emissions data is a data gap. Other pollutants are marked as not occurring or not applicable to the sector, except for PCDD/F from Chemical Industry: Other (NFR code 2B10a) which is marked as not estimated. No emissions are reported for NMVOC between 2002 and 2004 (these zero values are not plotted).

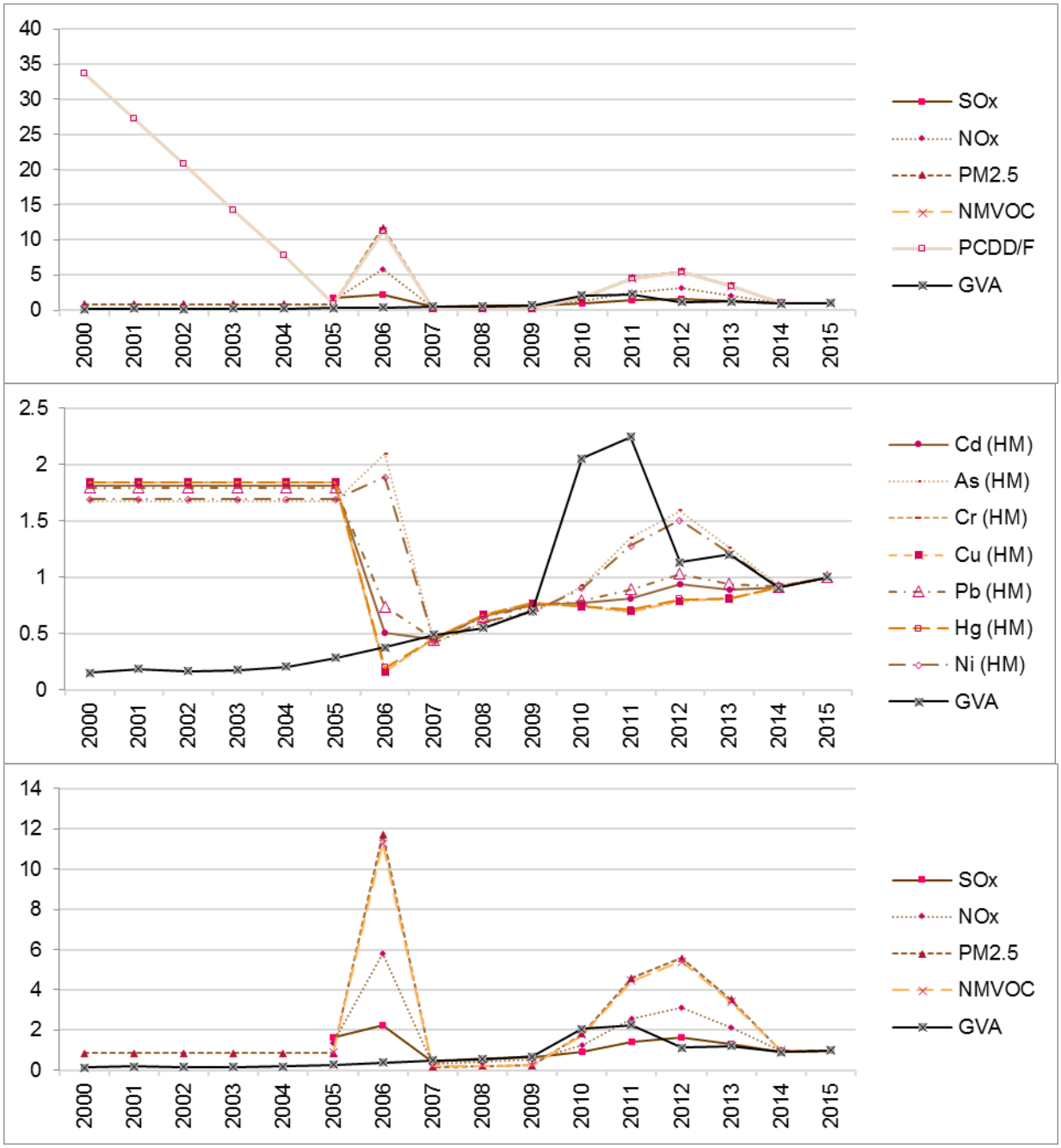
Source: EEA (2017a), Eurostat (2017a)

Waste management industry

Emissions to air from the hazardous waste management sector are shown in Figure 21. The trends indicate that emissions have decreased over time while GVA has grown. Furthermore, the quantity of emissions is comparatively low to emissions reported by other sectors (see detail in Appendix 2).

A data gap is identified for NH_3 and Zn which has not been estimated across the timeseries shown here (except for NH_3 in 2011); however, in light of the low quantities of the other pollutants emitted by the sector, it is expected that the significance of these data gaps is small.

Figure 21: Indexed emissions to air from hazardous waste (waste management industrial sector) (indexed to 2015=1)



Note: Emissions of NH_3 and Zn are marked as not estimated, meaning the lack of emissions data is a data gap. No emissions are reported for SO_x, NO_x and NMVOC between 2000 and 2004. Values are not plotted to avoid misrepresenting the trend. PCDD/F is removed from the third chart as an outlier to make the detail for the other pollutants visible.

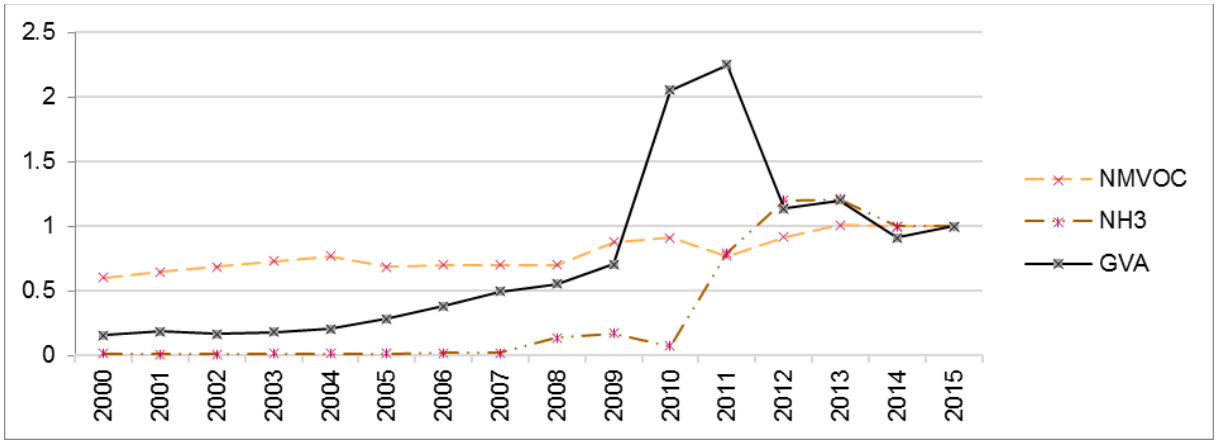
Source: EEA (2017a), Eurostat (2017a)

Similarly, emissions to air from the non-hazardous waste management sector are among the lowest across industry in Romania in terms of quantity (see Appendix 2). Despite the low quantity of emissions, the trends indicate that NH_3 emissions have been increasing over time and at a faster rate than the GVA growth for the sector. This suggests that emissions could present a challenge in future years if the trend continues (Figure 22); particularly in light of Romania's difficulty in meeting the EU landfill targets (section 6).

A data gap is identified for several pollutants which have not been estimated across the timeseries shown here; however, in light of the low quantities of the other pollutants emitted by the sector, it is expected that at the time of reporting the significance of these data gaps is small.

Emissions of HCl are not reported by CLRTAP; however, the pollutant is included in the national dataset and the non-hazardous waste management sector is one the main sources according to the 2015 dataset (reporting 180 kg in 2015) (MMEDIU, 2017c).

Figure 22: Indexed emissions to air from non-hazardous waste (waste management industrial sector) (indexed to 2015=1)



Note: Only NMVOC and NH_3 emissions are reported.

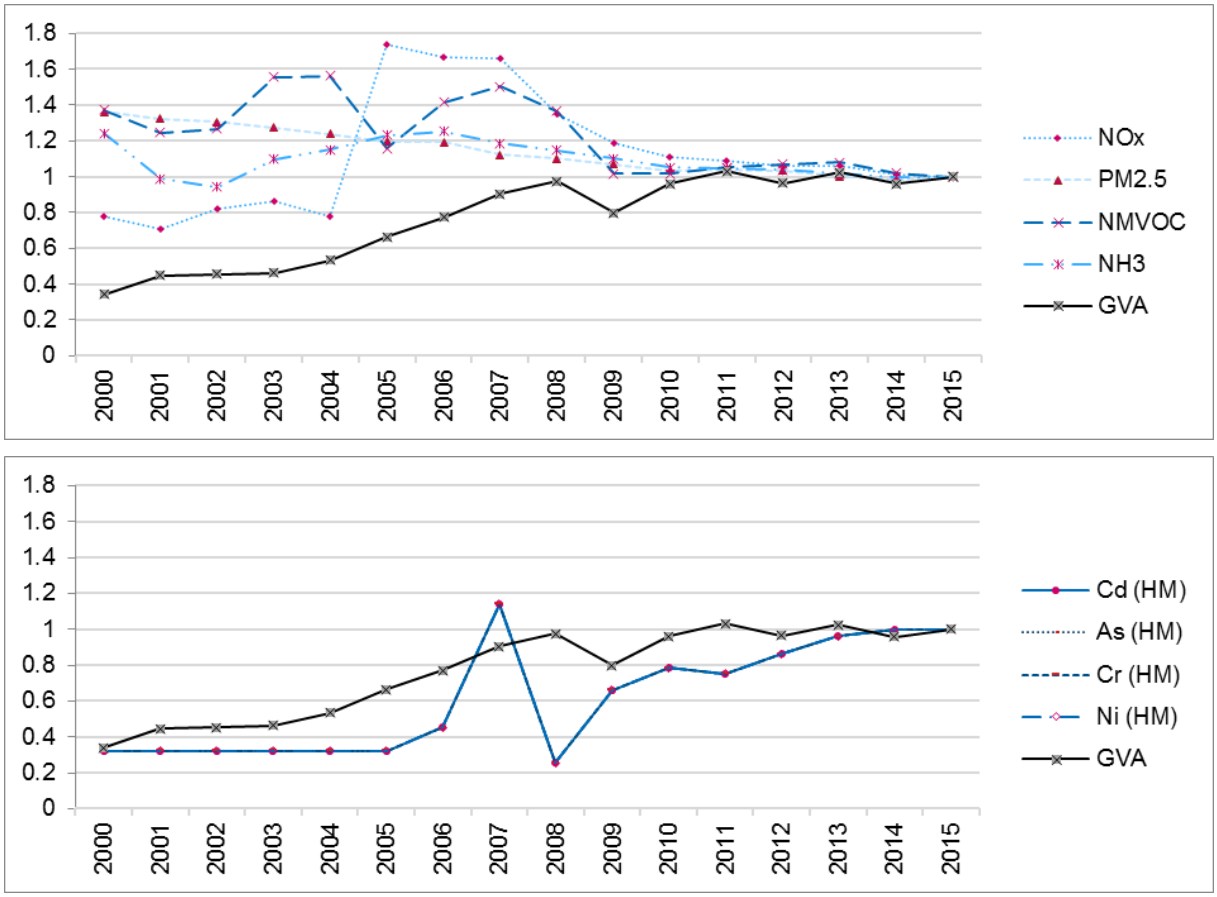
Source: EEA (2017a), Eurostat (2017a)

'Other activities'

Emissions to air from 'other activities' are shown in Figure 23. The trends indicate that emissions of NO_x, $PM_{2.5}$, NMVOC and NH_3 have decreased since 2005 while heavy metal emissions (Cd, As, Cr and Ni) have increased since 2005.

According to the CLRTAP dataset, there are several industries within 'other activities' where emissions have not been estimated, indicating that this is a data gap. Taking the national dataset (MMEDIU, 2017c) for the year 2015 as a point of comparison, the main pollutants emitted by 'other activities' include dust and NH_3 (namely from intensive rearing of poultry or pigs), and NMVOC (namely from the surface treatment industry). $PM_{2.5}$ (as an alternative to dust), NMVOC and NH_3 are included in the CLRTAP dataset. The national dataset also reported emissions of all heavy metals, highlighting the fact that the lack of data for Cu, Pb, Hg and Zn is indeed a data gap. Although the significance of this data in relation to the rest of emissions by industry is limited (Figure 13).

Figure 23: Indexed emissions to air from other activities (indexed to 2015=1)



Note: No emissions are reported for SO_x, PCDD/F, Cu, Pb, Hg and Zn. SO_x, and PCDD/F emissions are mainly not applicable to the sector and are not considered to be a data gap. The lack of emissions for the heavy metal pollutants are mainly not estimated, indicating that this is data gap (of limited significance).

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.

Further, limitations apply to the EU dataset used for Romania in light of the inconsistency with the national dataset – as described above in the narrative.

Table 6: Gaps in emissions to water data for Romania

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	Limited data reported for the mineral sector.	National data used

4.2 Emissions to water

Two data sources were used. First, data from the E-PRTR (EEA, 2017b), spanning the period from 2007 to 2015 and which has a broader industrial scope than the IED but is not a national total. The second data source used is from national reporting for industries regulated by the IED, covering the year 2015 and does not show IED emissions relative to the rest of the national total (MMEDIU, 2017c).

Figure 26, Figure 27 and Figure 28 in this section aggregate the separate metals into a single heavy metals metric based on their relative toxicity (predicted no effect concentrations), expressed in Hg equivalents. Note that where E-PRTR data is shown, As is not included in the aggregate total as no emissions were reported to the E-PRTR across any of the sectors.

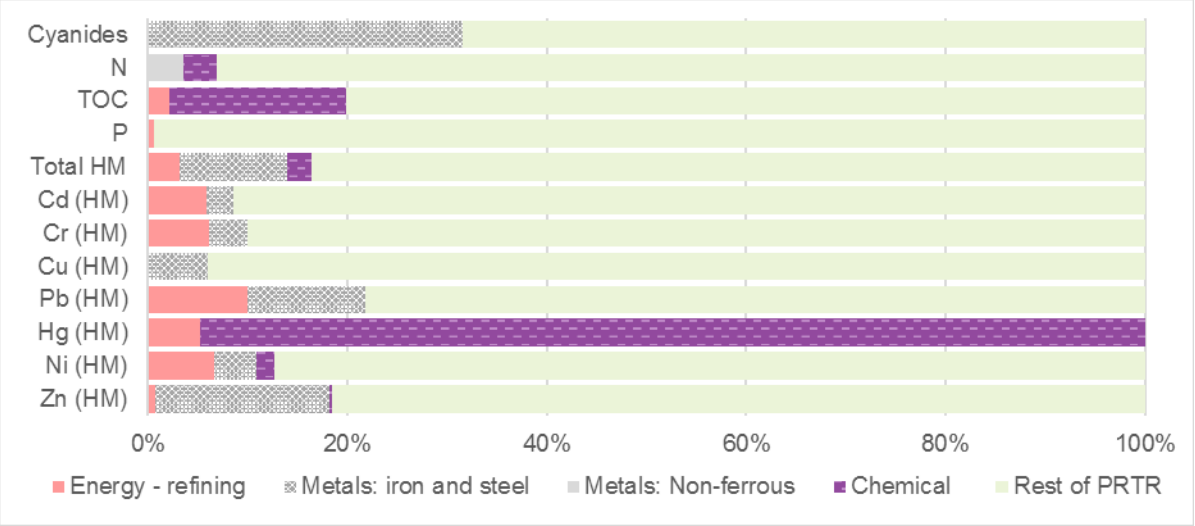
The PRTR dataset includes limited pollutant coverage up to 2015, with no data reported for PCDD/F, diuron, AOX, PCBs, or As. Full details on the emissions reported by industrial sector and year are presented in tabular format at the end of this section. The available data of emissions to water for the year 2015 are shown in Figure 24. This plot presents, per pollutant, the proportion of emissions to water by the industrial sector compared to the rest of the PRTR total reported by Romania in 2015.

The national reporting dataset has a similar scope in pollutants reported (with no data reported for diuron, PCDD/F, AOX and PCBs), although it does include emissions data for As (indicating that the main source of these emissions is the energy -power sector) (MMEDIU, 2017d) (Figure 25). The two datasets also show a similar picture in terms of the main sources of pollutants being the chemical sector, iron and steel production and the energy – refining sector. The national dataset also indicates that 'other activities' is a significant source of total N (namely from intensive rearing of poultry or pigs) and emits a number of other pollutants.

While the two data sources cover the same sectors, the national reporting dataset includes emissions data for energy – power and 'other activities' for the year 2015. The PRTR dataset only reports heavy metal emissions from the energy – power sector and only in 2007. This indicates that emissions after 2007 were below the PRTR reporting threshold, and as shown by the national dataset account for a relatively low share of total emissions in 2015. For 'other activities', the PRTR dataset includes reporting for a wider scope of pollutants and over a longer timeseries (Table 7). In light of the national dataset, the lack of PRTR data in 2015 again indicates that emissions were below the PRTR reporting threshold in 2015.

The following sections discuss the emission trends between 2000 and 2015 by industrial sector. The trends show reported increases of emissions to water for select pollutants from the chemical and energy – refining sectors, as discussed in the following sections (see Table 7 for additional detail concerning the quantity of emissions).

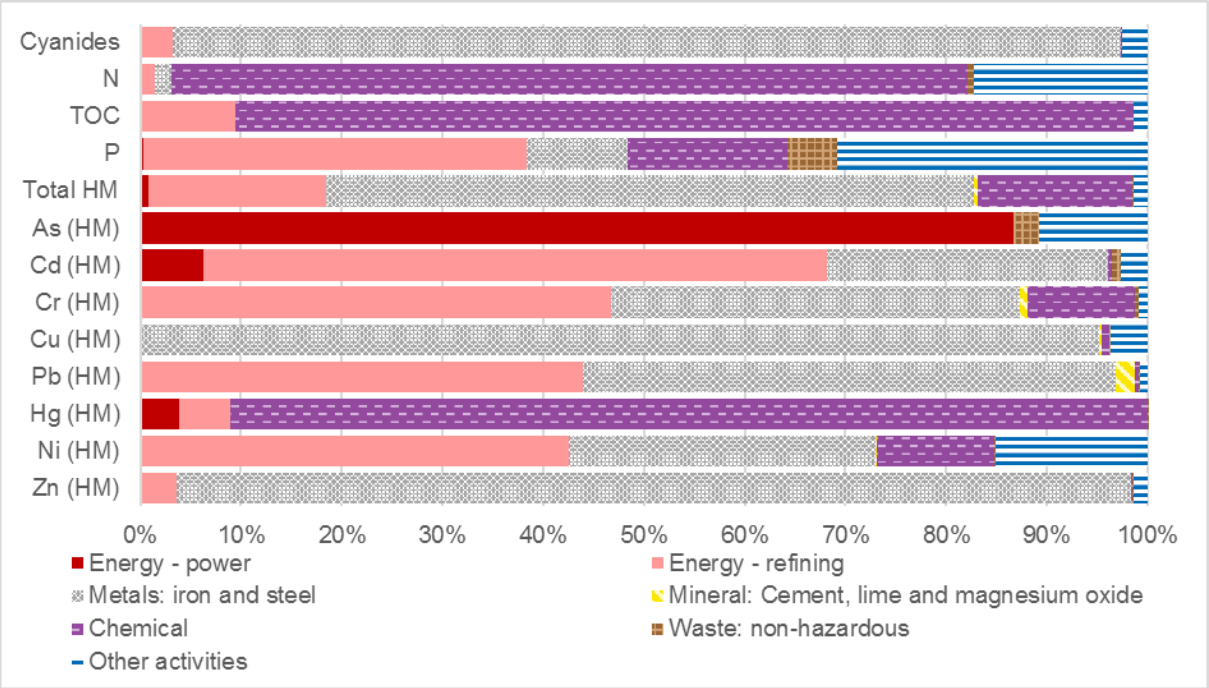
Figure 24: Pollutant emissions to water from industrial sectors and rest of PRTR total (2015)



Notes: Rest of PRTR total relates to the rest of national reporting to the E-PRTR. No data is reported in 2015 for As, AOX, PCBs, PCDD/F and diuron. Emissions to water data is only reported for limited industrial sectors.

Source: EEA (2017b)

Figure 25: National reporting of emissions to water from industrial sectors (2015)



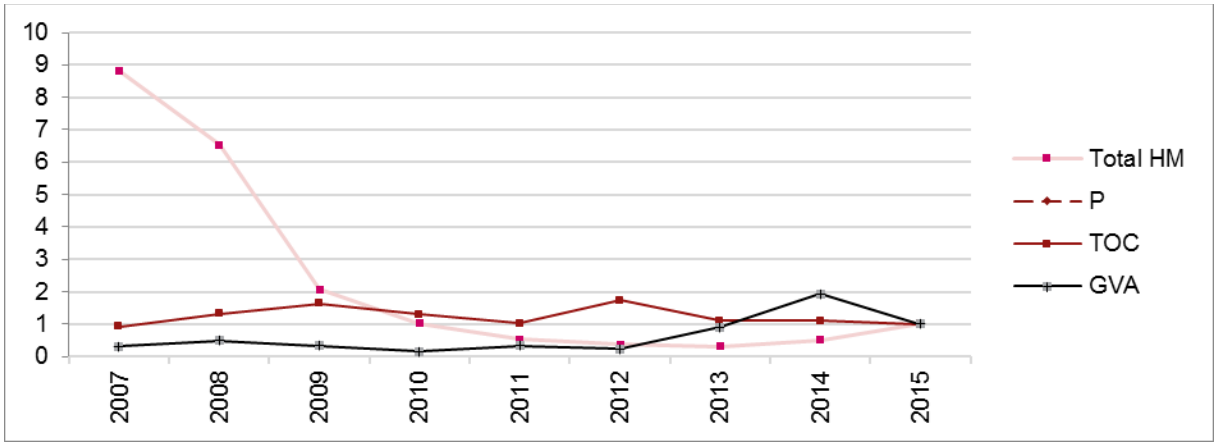
Source: MMEDIU (2017d)

Energy industry

Limited emissions to water from the energy – power sector are reported for Romania. No trends could be identified – see Table 7 for details.

Emissions to water of aggregate heavy metals (comprising mainly Zn in the years between 2007 and 2009 when emissions were greatest) and TOC from the energy – refining sector are reported between 2007 and 2015, and for total P in 2015 only. Emissions have decreased over time while GVA has grown. However, increases are reported for total heavy metals since 2013 (Figure 26). The GVA for the sector has grown since 2012, with a marked spike in 2014 and the number of permitted installations growing from 7 to 11 between 2011 and 2015. As the increase in emissions coincides with this sector growth, it is expected that emissions will also increase and the fact that the increases are marginal suggests that emissions to water are not a challenge for the sector.

Figure 26: Indexed emissions to water from the energy - refining industrial sector (indexed to 2015=1)



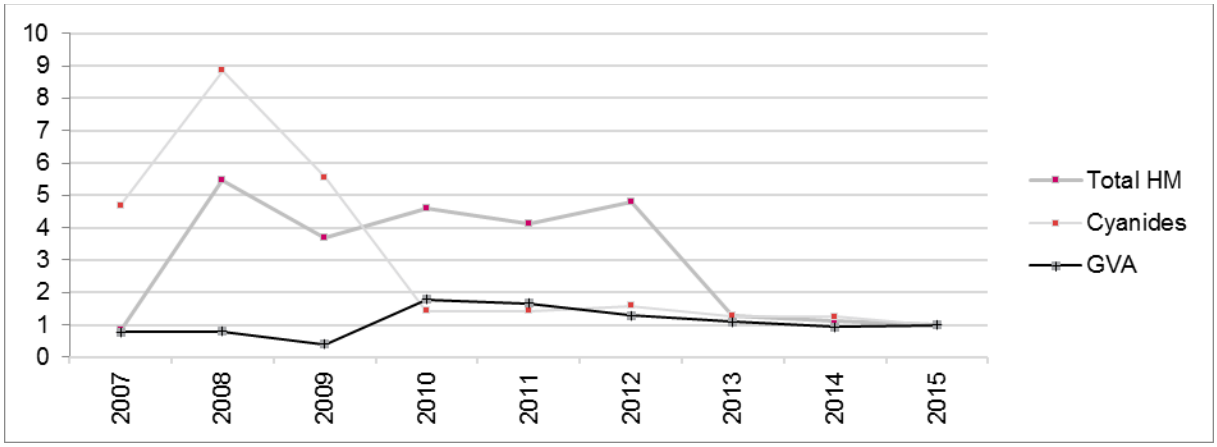
Notes: Only total heavy metals, total P and TOC emissions reported. No emissions reported for total P between 2007 and 2014 inclusive. Values not plotted for these years to avoid misrepresenting trends.

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

Metal industry

Emissions to water from iron and steel production were reported for heavy metals and cyanides. The elevated heavy metal emissions reported between 2008 and 2012 are linked with increased Cr, Pb and Zn emissions, and reporting of Cd (not reported in other years). The trend for both heavy metals and cyanides shows that emissions have reduced over time while GVA has remained relatively constant.

Figure 27: Indexed emissions to water from the iron and steel industrial sector (indexed to 2015=1)



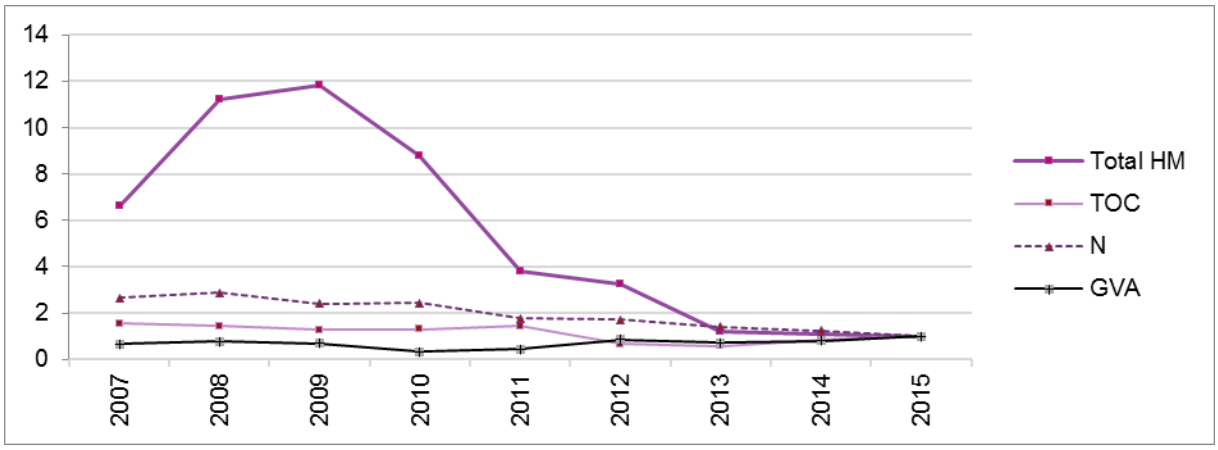
Note: Only total heavy metals and cyanides emissions reported.
Source: EEA (2017b), Eurostat (2017a)

No emissions reported for total N from the non-ferrous metal sector between 2000 and 2014 (no trend). Values not plotted for these years to avoid misrepresenting trends.

Chemical industry

The time series for emissions to water for the chemical sector are illustrated in Figure 28. Emissions are reported for heavy metals (comprising Hg), total N and TOC. The trend for all three pollutants shows that emissions have reduced over time while GVA has grown slightly.

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



Note: Only TOC and total N and heavy metal emissions reported. Heavy metal emissions presented here in aggregate form by PNEC value.

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.

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

	Unit	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - power										
Total HM	kg	4.33	-	-	-	-	-	-	-	-
Energy - refining										
Total HM	kg	380	281	89	44	23	16	14	22	43
P	t	-	-	-	-	-	-	-	-	5.15
TOC	t	346	498	617	490	385	654	416	412	377
N	t	100	176	146	99	-	-	-	-	-
Cyanides	kg	80	-	-	81	-	-	-	-	-
Metals: iron and steel										
Total HM	kg	123	817	550	689	616	716	188	165	149
N	t	659	1,200	1,180	225	232	-	-	-	-
Cyanides	kg	5,300	10,000	6,280	1,600	1,600	1,780	1,440	1,420	1,130
Metals: Non-ferrous										
Total HM	kg	62.62	25.76	0.90	-	-	-	-	-	-
N	t	-	-	-	-	-	-	-	-	339
Chemical										
Total HM	kg	232	394	415	308	134	114	42	38	35
P	t	7.00	5.44	-	-	5.28	-	-	-	-
TOC	kt	4.85	4.53	4.02	4.06	4.54	2.04	1.83	2.60	3.13
N	t	894	960	806	813	594	576	470	419	335
Waste: non-hazardous										
P	t	14	-	-	-	-	-	-	-	-
TOC	t	52	-	-	53	-	-	-	-	-
Other activities										
Total HM	kg	31	12	2.08	13.76	1.52	-	-	-	-
P	t	62	30	97	36	51	7.05	7.30	7.30	-
TOC	kt	2.57	1.53	0.16	-	-	-	-	-	-
N	t	463	267	465	692	241	89	-	-	-

Notes: Industrial sectors and pollutants with no data reported across the timeseries have been removed. Total heavy metals in kg is expressed in Hg equivalents using reciprocal predicted no effect concentrations.

Source: EEA (2017b)

Limitations

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

Further, limitations apply to the EU dataset used for Romania in light of the inconsistency with the national dataset – as described above in the narrative.

Table 8: Gaps in emissions to water data for Romania

Missing data	Description	Conclusion and actions taken#
Limited pollutant coverage	No data reported for the mineral sector or hazardous waste management	National data included for 2015.
Limited time series	Reduced time series.	No action

5 Waste generated by industrial sectors

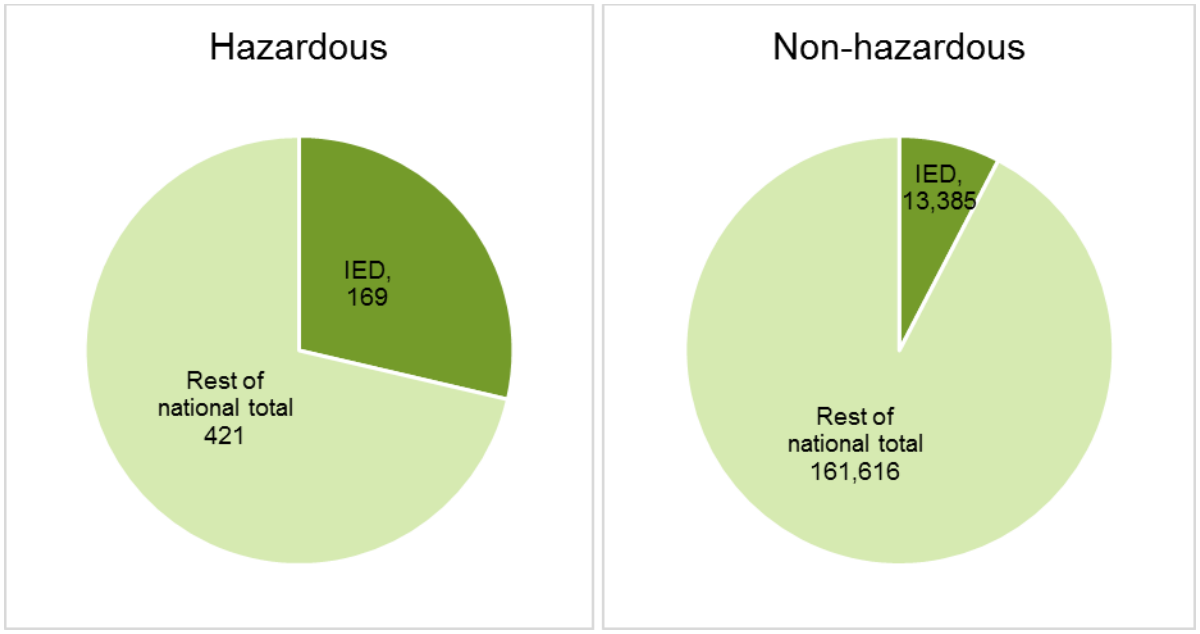
The data presented in this section is the generation of waste by waste category (hazardous and non-hazardous) (Eurostat, 2017e). Data is reported by Member States biennially.

In addition to Eurostat data for waste generation (Eurostat, 2017e), national data was provided by the national competent authority for the year 2015 (MMEDIU, 2017e). The two datasets vary, with the greatest differences reported for the generation of non-hazardous waste by the energy – refining, metals, and waste management sectors and 'other activities'. In total, in 2014, Eurostat reported 169 kt of hazardous waste generated by the industrial sectors and 13,385 kt of non-hazardous waste, while the national reporting indicated that in 2015, 298 kt of hazardous waste was generated by the industrial sectors and 15,209 kt of non-hazardous waste.

As the national dataset only includes data for the waste generated by industrial sectors, it is not presented relative to the rest of the national totals as it was decided not to combine the national reporting with the Eurostat data.

Taking the Eurostat data, in 2014, industrial sectors account for almost a third of total hazardous waste generated in Romania (29% of the national total) but much less of total non-hazardous waste generated (8% of the national total) (Figure 29).

Figure 29: Waste generation by industrial sectors compared to the national total in 2014 (kt)



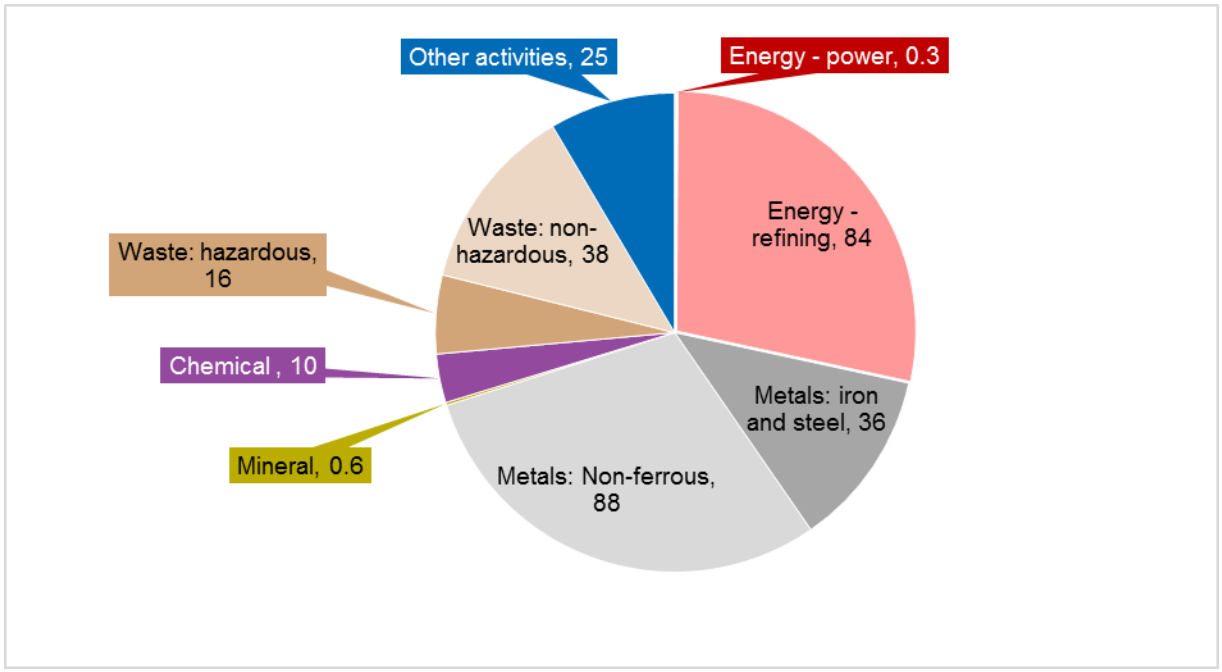
Note: Rest of national total relates to all NACE activities minus industrial sectors (comprising energy – power, energy – refining, metal, mineral, chemical, waste management and 'other activities').

Source: Eurostat (2017e)

The breakdown by industrial sector illustrated in the following charts shows that the metal sector is the main source of hazardous waste generated by Romanian industry (accounting for 42% of the industry waste). The energy – refining and waste management sectors are also significant sources of waste generated (accounting for 28% and 18% of the industry total, respectively) (Figure 30). The waste generated by the waste management sector is secondary waste and typical waste streams from this sector that require disposal include a mixture of ash, carbon and lime residue, bottom ash, leachate, bioaerosols and discards.

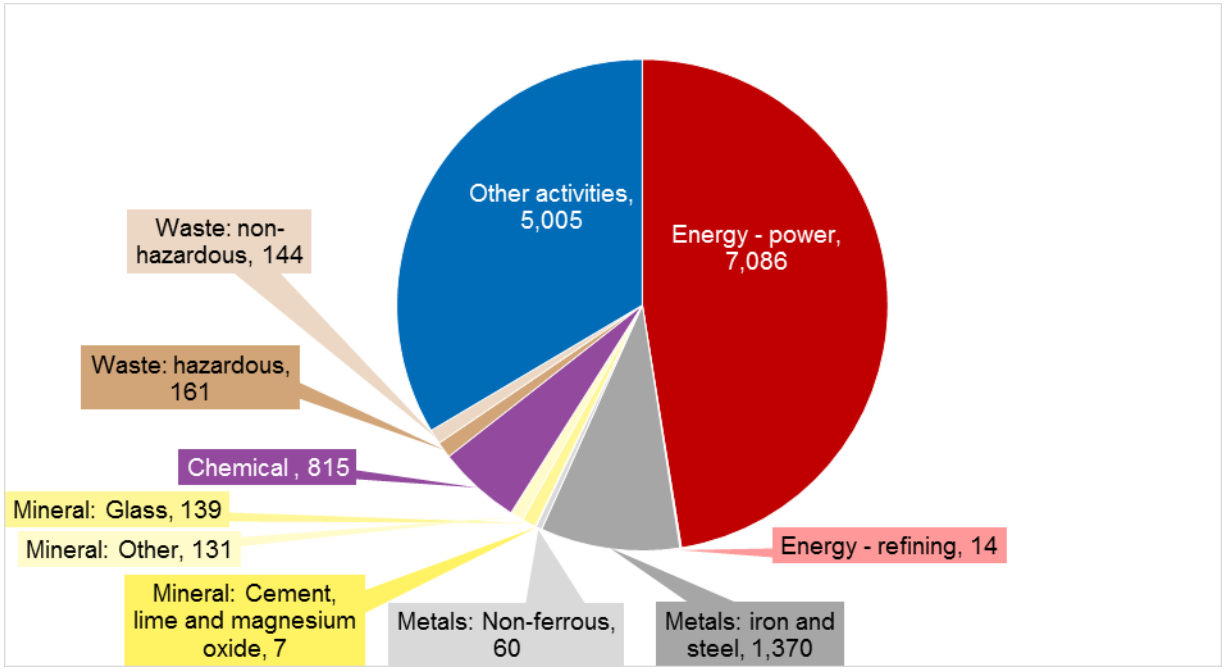
Although a smaller share of the national total, the quantity of non-hazardous waste generated by industry is greater than the hazardous waste generated. The energy – power sector and surface treatment industries within 'other activities' generate the largest share of this waste (47% and 34%, respectively) (Figure 31).

Figure 30: National reporting of hazardous waste generation by industrial sector in 2015 (kt)



Source: MMEDIU (2017e)

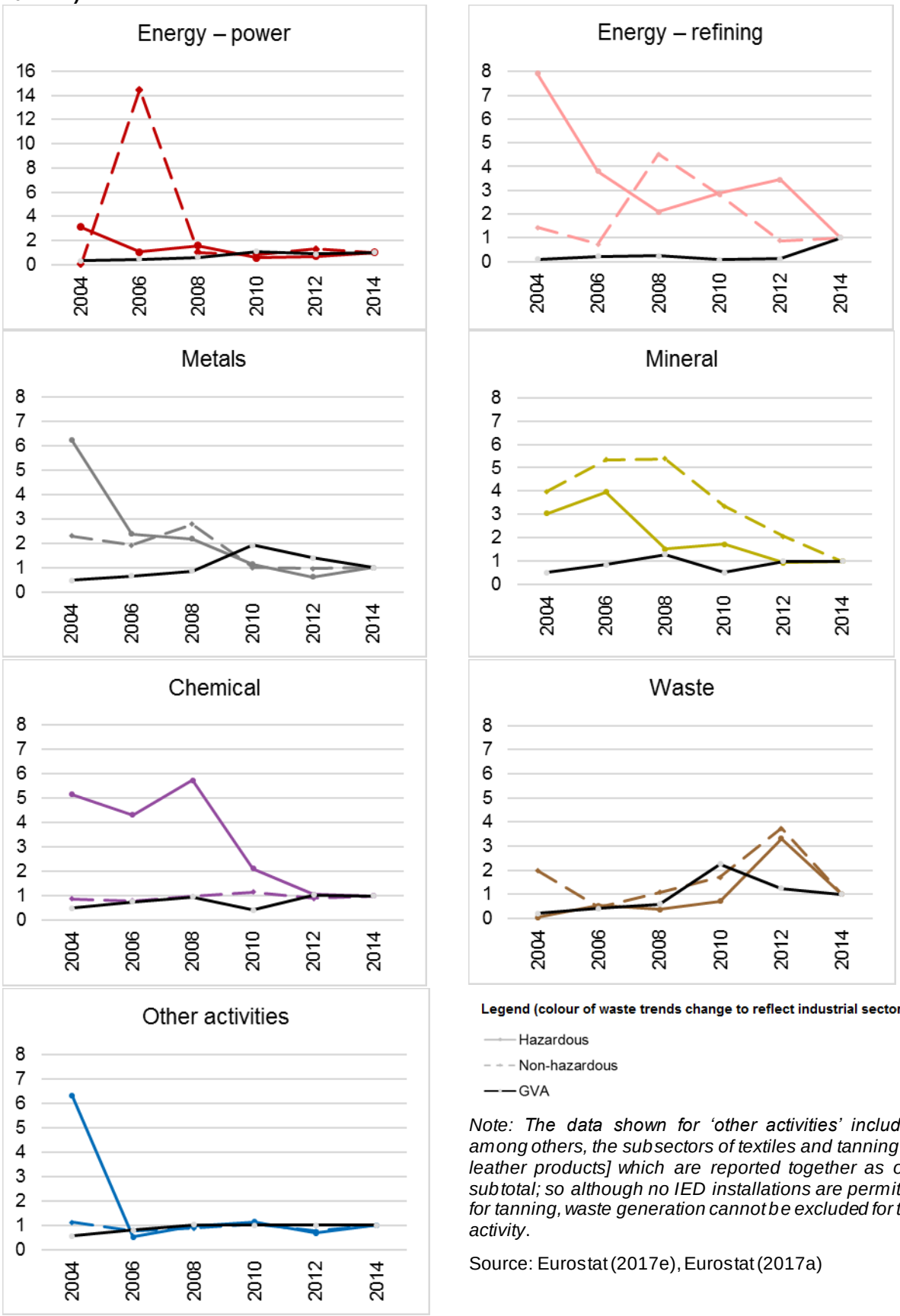
Figure 31: National reporting of non-hazardous waste generation by industrial sector in 2015 (kt)



Source: MMEDIU (2017e)

The trends in time of waste generated per industrial sector are plotted indexed against industrial sector GVA in Figure 32. Over time, the quantity of non-hazardous waste generated by the energy - power has increased with an additional spike in generation apparent for the year 2006. From the waste management sector, the quantity of non-hazardous waste generated peaked in 2012 but has since been declined. This trend for the waste management sector is relevant to one of the challenges discussed in section 6 concerning EU landfill targets (European Commission, 2017).

Figure 32: Hazardous and non-hazardous waste generation by industrial sector relative to GVA (indexed; 2014 = 1)



Note: 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, waste generation cannot be excluded for this activity.

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

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.

Table 9: Gaps in waste data for Romania

Missing data	Description	Conclusion and actions taken
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, waste generation cannot be excluded for this activity.	No action

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 or political intervention or implementation of a specific national policy or which are evident from literature or analysis[3].

As shown in section 2, the industrial sectors comprise a relatively small share of the total GVA across all economic activities in Romania (16%). The main industrial sector in Romania, according to the number of IED installations reported, is intensive rearing of poultry or pigs, comprising 48% of total IED installations in 2015. This is followed by the waste management sector (11%).

The quantitative analysis in section 4 shows that the main source of emissions to air is the energy – power sector. Despite the significance of the energy sector in relation to other sectors, the trends indicate that emissions have decreased over time, while GVA has grown. This indicates that the corresponding challenge for the energy – power sector identified in Table 10 is being addressed by the sector.

The quantitative data indicates that additional challenges with respect to emissions to air may exist for the metal and mineral sectors owing to increased emissions reported in more recent years. Similarly, increased emissions to water from the chemical and energy – refining sectors are reported in recent years which could mark additional challenges to those identified here.

Another challenge identified in this profile concerns the EU landfill target (Table 10). This challenge is reflected in the timeseries data for waste generated by industry which shows that, over time, the quantity of non-hazardous waste generated by the energy – power and the waste management sectors has increased.

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

Table 10: Key challenges identified in Romania

Energy security	RO-1
IED activities / sectors	1.1. Combustion of fuels in installations with a total rated thermal input of 50 MW or more
Medium and pollutants	Emissions to air (main pollutant PM)
Description	The country hosts some of the most polluting lignite plants in the EU (WWF, 2016). The 2310MW Complexul Energetic Turceni plant is the largest power plant in Romania, making use of lignite fuel, and is 3rd on the EEA's list of most damaging facilities. Complexul Energetic Rovinari is a 1,320MW lignite plant that is 6th on the EEA's list of most damaging facilities (EEA, 2015). These plants are responsible for ~1/3 of Romania's electricity supply. Although neither facility is situated in the current air quality zones exceeding the AQD limit values in Romania, these facilities emit large amounts of PM_{10} contributing to heightened ambient concentrations of PM_{10} and there is difficulty meeting the AQD limit values.
Years applicable / current	2010 - Ongoing
Related infringement cases	
Public complaints	None identified
Media Attention	Coverage by specialised media sources as well as environmental NGOs (e.g. WWF report on the dark cloud and ENDS Europe).
Political interventions	None identified
Policies implemented to address challenge	None identified
Related policies	Climate policy

Failure to meet landfill targets	RO-2
IED activities / sectors	5.4 Landfills
Medium and pollutants	Not specified in the documentation reviewed
Description	Against EU targets to reduce landfill by 50% in 2009 from 2006 and by 35% by 2016 from 2009 levels, Romania was given a derogation to delay meeting these targets until 2014 and 2020. Suggestions to facilitate Romania with meeting its targets include: increase landfill charges; and improved collection systems (European Commission, 2017).
Years applicable / current	Ongoing
Related infringement cases	None identified
Public complaints	None identified
Media Attention	None identified
Political interventions	None identified
Policies implemented to address challenge	None identified
Related policies	Romania has been taken to the EU Court of Justice for failure to transpose the EU legislation on packaging waste. It is considered that transposition and implementation of this legislation would also reduce landfill (European Commission, 2015; 2017)

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Appendices

Appendix 1 Mapping industrial sectors across data sources for Romania

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

Appendix 1 - Mapping industrial sectors across data sources for Romania

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	Combustion of fuels (1c)	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_101320 - Non-specified (Energy)	Processing and cooling in the oil refinery sector	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	Iron and steel manufacturing (2b-d)	C24-C25 (basic metals; fabricated metal products, except machinery and equipment)
Metals: non-ferrous			B_101810 - Non-Ferrous Metals		2C2-7 Non-ferrous metals	Non-ferrous metal production (2e)	
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	Glass (3e)	
Mineral: Other					2A6 Other	Other (3f-g)	
Chemical	C20 (chemicals); C21 (pharmaceutical products)	C20 (chemicals); C21 (pharmaceutical products)	B_101815 - Chemical and Petrochemical	DATASETS COMBINED: C20 (chemicals) and C21 (pharmaceutical products) AND C19 (coke and refined petroleum products)	2B1 Ammonia; 2B6 Titanium dioxide; 2B2 Nitric acid; 2B7 Soda ash; 2B3 Adipic acid; 2B10a Other; 2B5 Carbide; 2J Production of POPs	Chemical industry (4a-c, 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	Hazardous waste (5a)	E37-E39 (water supply; sewerage, waste management and remediation)
Waste: non-hazardous			B_101318 - Gasification plants for biogas	*Insufficient granularity in reported data*	5A Solid waste disposal on land; 5C1a Municipal waste incineration; 5B1 Composting; 5C1bv Cremation; B2 Anaerobic digestion at biogas facilities; 5D2 Industrial wastewater handling	Non-hazardous waste (5b-e; g)	
Other: **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	DATASETS COMBINED: C10-12 (food and drinks and tobacco); C13-15 (textiles; wearing apparel; leather); C16-17 (paper and wood products)	C16-17 (paper, paper products and wood-based products)	Pulp, paper and wood production (6a-c)	C16-C18 (paper, paper products and wood-based products; printing)
Textiles	C13-15 (textiles and tanning)	C13 (textiles)	B_101835 - Textile and Leather		*Unavailable*	Pre-treatment or dyeing of textile fibres or textiles (9a)	C13-15 (textiles and tanning)
Food and drink products	C10-C12 (food and drinks and tobacco)	C10 (food products); C11 (drink products)	B_101830 - Food and Tobacco		2H Food and beverages industry	Food and drink (8a-c)	C10-C12 (food products; drink products; tobacco)
Intensive rearing of poultry and pigs	*Unavailable*	*Unavailable*	*Unavailable*	*Insufficient granularity in reported data*	3B3 Manure management – Swine; 3B4gi Manure management - Laying hens; 3B4gii Manure management - Broilers	Intensive rearing of poultry and pigs (7a)	*Unavailable*
Surface treatment	*Unavailable*	*Unavailable*	*Unavailable*	*Insufficient granularity in reported data*	2D3d Coating applications; 2D3e Degreasing; 2D3f Dry cleaning; 2D3g Chemical products; 2D3h Printing; 2D3i Other solvent use; 2G Other product use; 2H3 Other industrial processes	Surface treatment (2f; 9c); Production of carbon (9d)	*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)	*All national E-PRTR reporting*	*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 Ireland (excluded indicators are: B_101312 - Coke Ovens; 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 Romania (excluded activities include: Energy [gasification and liquefaction (1b), coke ovens (1c)]; 'Other activities' [Tanning of hides and skins (9b)]
* Sector mappings not shown for tanning (C15) as there are no IED installations for these sectors reported.

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

Note: Industrial sectors and pollutants with no data reported across the timeseries have been removed.

Source: EEA (2017a)

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - power																	
SO_x	kt	429	473	437	468	428	575	627	503	501	429	336	307	246	191	162	137
NO_x	kt	121	130	121	130	117	165	200	146	146	108	97	100	95	81	81	81
$PM_{2.5}$	kt	15.02	14.22	13.53	13.16	12.84	11.16	12.85	11.11	10.43	9.17	7.28	6.77	6.82	6.14	5.82	6.37
NMVOC	kt	2.80	2.96	3.58	3.67	3.84	18.97	20.93	19.75	17.26	13.53	14.11	14.04	13.54	12.34	12.16	12.28
NH_3	t	1.82	1.45	1.38	1.61	1.69	1.81	1.60	2.96	1.45	0.78	1.03	0.62	1.06	0.25	0.90	1.00
Cd (HM)	t	0.89	0.88	0.87	0.86	0.86	0.83	0.91	0.93	0.86	0.75	0.72	0.78	0.70	0.59	0.60	0.61
As (HM)	t	4.63	4.60	4.58	4.57	4.56	4.50	4.99	4.96	5.06	4.34	4.03	4.71	3.85	3.06	3.19	3.30
Cr (HM)	t	4.32	4.23	4.15	4.11	4.08	3.87	4.29	4.33	4.16	3.50	3.32	3.68	3.18	2.63	2.68	2.80
Cu (HM)	t	2.58	2.46	2.35	2.30	2.26	2.00	2.13	2.02	1.99	1.72	1.34	1.35	1.30	1.10	1.08	1.22
Pb (HM)	t	17.75	16.90	16.12	15.78	15.61	13.55	14.64	14.43	12.95	9.83	9.82	10.05	9.15	7.80	7.60	8.29
Hg (HM)	t	1.97	1.91	1.86	1.84	1.82	1.69	1.86	1.87	1.81	1.43	1.38	1.51	1.34	1.11	1.14	1.22
Ni (HM)	t	26.78	24.18	22.29	19.41	15.98	14.97	12.68	7.49	6.72	7.87	5.23	6.03	5.03	2.97	2.85	3.16
Zn (HM)	t	34.97	33.51	32.25	31.60	31.02	27.95	30.76	28.31	24.80	21.65	18.90	17.98	18.39	16.50	15.92	17.06
PCDD/F	g	325.13	262.78	200.43	138.08	75.73	40.63	45.62	48.40	46.54	35.10	32.45	34.25	34.26	29.65	30.77	34.66

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Energy - refining																	
SO_x	kt	9.17	9.78	13.03	10.89	14.96	9.47	10.45	8.38	6.18	2.67	1.40	0.89	0.37	0.21	0.40	0.39
NO_x	kt	15.72	15.87	19.51	16.64	17.33	2.72	3.22	2.81	2.25	0.91	0.56	0.55	0.54	0.37	0.56	0.45
$PM_{2.5}$	kt	7.21	6.50	5.89	5.49	5.22	3.79	4.06	3.66	2.56	0.78	0.02	0.01	0.004	0.002	0.002	0.002
NMVOC	kt	0.37	0.60	0.43	0.43	0.41	0.08	0.09	0.07	0.06	0.03	0.02	0.01	0.007	0.005	0.004	0.004
NH_3	t	87	70	66	77	81	87	93	86	59	18	0.10	-	-	-	-	-
Cd (HM)	kg	218	196	178	165	156	114	122	108	76	23	0.79	0.62	0.09	0.002	0.001	0.001
As (HM)	kg	1,443	1,302	1,179	1,099	1,045	758	812	733	512	156	3.89	2.59	0.65	0.27	0.26	0.21
Cr (HM)	kg	754	680	616	574	545	395	423	380	266	81	1.85	1.32	0.19	0.004	0.002	0.001
Cu (HM)	kg	3,233	2,917	2,641	2,465	2,347	1,700	1,820	1,656	1,152	347	4.85	2.74	0.40	0.0055	0.0002	0.0002
Pb (HM)	kg	3,608	3,256	2,948	2,752	2,621	1,898	2,033	1,852	1,287	388	4.90	2.56	0.37	0.008	0.003	0.003
Hg (HM)	kg	3,803	3,434	3,108	2,906	2,773	2,006	2,148	1,975	1,368	410	3.21	0.62	0.32	0.22	0.22	0.18
Ni (HM)	kg	3,885	3,393	3,152	2,714	2,332	1,787	1,935	872	863	383	140.66	131.44	18.97	0.25	0.001	0.001
Zn (HM)	kg	6,935	6,223	5,660	5,213	4,885	3,568	3,828	3,209	2,311	735	51.85	45.26	6.54	0.09	0.003	0.003
PCDD/F	mg	-	-	-	-	-	1,753	1,878	1,719	1,195	361	6.93	3.52	1.68	1.10	1.08	0.89
Metals: iron and steel																	
SO_x	kt	0.09	0.10	0.12	0.12	0.13	0.11	0.11	0.11	0.10	0.06	0.10	0.12	0.10	0.07	0.08	0.07
NO_x	kt	0.23	0.25	0.30	0.31	0.32	0.28	0.29	0.29	0.25	0.15	0.25	0.27	0.24	0.17	0.19	0.18
$PM_{2.5}$	kt	1.21	1.13	1.04	0.98	0.95	0.77	0.76	0.76	0.61	0.33	0.43	0.44	0.39	0.36	0.38	0.41
NMVOC	kt	0.06	0.06	0.08	0.08	0.09	0.99	0.99	0.99	0.81	0.45	0.62	0.64	0.57	0.50	0.52	0.55
Cd (HM)	t	1.03	0.96	0.89	0.85	0.84	0.68	0.70	0.70	0.58	0.33	0.50	0.53	0.47	0.37	0.40	0.40
As (HM)	t	3.16	2.92	2.67	2.51	2.42	1.94	1.89	1.89	1.45	0.78	0.89	0.85	0.77	0.84	0.84	0.97
Cr (HM)	t	17.32	16.05	14.63	13.79	13.26	10.65	10.34	10.32	7.94	4.26	4.81	4.57	4.16	4.55	4.57	5.29
Cu (HM)	t	0.62	0.58	0.53	0.50	0.49	0.39	0.39	0.39	0.31	0.17	0.22	0.23	0.20	0.19	0.19	0.21
Pb (HM)	t	70.27	65.35	60.00	56.92	55.43	44.62	44.34	44.35	35.42	19.42	25.51	25.87	23.24	21.42	22.15	24.00
Hg (HM)	t	0.62	0.58	0.53	0.51	0.50	0.40	0.41	0.41	0.34	0.19	0.27	0.29	0.26	0.21	0.22	0.23
Ni (HM)	t	3.57	3.35	3.11	2.98	2.96	2.39	2.46	2.47	2.08	1.17	1.81	1.94	1.72	1.34	1.43	1.44
Zn (HM)	t	39.42	36.67	33.68	31.97	31.16	25.09	24.97	24.98	20.00	10.98	14.55	14.81	13.30	12.13	12.57	13.56
PCDD/F	g	-	-	-	-	-	58.67	58.84	58.91	47.71	26.37	36.37	37.59	33.64	29.40	30.72	32.52

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Metals: Non-ferrous																	
SO_x	kt	0.16	0.16	0.17	0.18	0.19	1.43	1.60	1.58	1.87	1.21	1.25	1.34	1.22	1.19	1.17	1.24
NO_x	kt	-	-	-	-	-	0.24	0.27	0.26	0.31	0.20	0.21	0.22	0.20	0.20	0.20	0.21
$PM_{2.5}$	kt	0.49	0.48	0.46	0.44	0.42	0.42	0.42	0.39	0.45	0.29	0.31	0.33	0.29	0.28	0.27	0.29
Cd (HM)	kg	366.79	366.79	366.79	366.79	366.79	366.79	344.26	343.78	297.62	1.48	1.29	1.06	0.88	0.60	0.30	0.57
As (HM)	kg	816.16	816.16	816.16	816.16	816.16	816.16	847.42	720.81	527.55	0.18	0.20	0.13	0.06	0.04	0.03	0.04
Cr (HM)	t	0.33	0.33	0.33	0.33	0.33	0.33	0.35	0.29	0.21	-	-	-	-	-	-	-
Cu (HM)	t	1.45	1.45	1.45	1.45	1.45	1.45	1.51	1.28	0.93	-	-	-	-	-	-	-
Pb (HM)	t	4.74	4.74	4.74	4.74	4.74	4.74	4.57	4.38	3.64	0.12	0.15	0.09	0.02	0.02	0.02	0.02
Hg (HM)	t	0.32	0.32	0.32	0.32	0.32	0.32	0.25	0.33	0.34	0.01	0.01	0.01	0.003	0.002	0.002	0.002
Ni (HM)	t	0.29	0.29	0.29	0.29	0.29	0.29	0.30	0.26	0.19	-	-	-	-	-	-	-
Zn (HM)	t	2.50	2.50	2.50	2.50	2.50	2.50	1.94	2.57	2.70	0.07	0.08	0.05	0.02	0.02	0.01	0.02
PCDD/F	g	130.47	105.45	80.43	55.41	30.39	0.56	0.47	0.56	0.55	0.05	0.06	0.04	0.01	0.01	0.01	0.01
Mineral: Cement, lime and magnesium oxide																	
SO_x	kt	1.82	1.70	1.70	1.80	1.87	-	-	-	-	-	-	-	-	-	-	-
$PM_{2.5}$	kt	2.17	2.17	2.17	2.17	2.17	2.17	2.43	2.74	2.91	2.12	2.10	2.23	2.26	2.15	2.20	2.42
PCDD/F	g	1.33	1.08	0.82	0.57	0.31	-	-	-	-	-	-	-	-	-	-	-

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Chemical																	
SO_x	kt	0.04	0.03	0.03	0.04	0.04	-	-	-	-	-	-	-	-	-	-	-
NO_x	kt	5.71	5.14	5.35	3.47	2.25	6.19	8.12	5.73	5.75	4.46	6.13	5.57	5.38	4.63	4.83	1.28
$PM_{2.5}$	kt	0.26	0.26	0.26	0.26	0.26	0.26	0.15	0.18	0.20	0.08	0.03	0.09	0.14	0.10	0.06	0.06
NMVOC	kt	0.32	0.23	-	-	-	15.24	10.99	11.20	15.97	8.42	10.14	11.04	8.77	6.58	6.92	4.26
NH_3	kt	1.06	0.85	0.81	0.94	0.99	1.06	0.83	0.93	1.01	0.61	0.43	0.64	0.79	0.68	0.54	0.62
Waste: hazardous																	
SO_x	kt	-	-	-	-	-	0.008	0.011	0.002	0.003	0.003	0.005	0.007	0.008	0.006	0.004	0.005
NO_x	kt	-	-	-	-	-	0.04	0.19	0.01	0.01	0.02	0.04	0.09	0.10	0.07	0.03	0.03
$PM_{2.5}$	kt	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0009	0.0000	0.0000	0.0000	0.0001	0.0003	0.0004	0.0003	0.0001	0.0001
NMVOC	kt	-	-	-	-	-	0.12	1.60	0.03	0.03	0.04	0.25	0.63	0.77	0.48	0.14	0.14
NH_3	kt	-	-	-	-	-	-	-	-	-	-	-	0.003	-	-	-	-
Cd (HM)	t	0.110	0.110	0.110	0.110	0.110	0.110	0.031	0.028	0.040	0.046	0.047	0.050	0.057	0.054	0.055	0.061
As (HM)	t	0.003	0.003	0.003	0.003	0.003	0.003	0.0037	0.0007	0.001	0.001	0.002	0.002	0.003	0.002	0.002	0.002
Cr (HM)	t	0.027	0.027	0.027	0.027	0.027	0.027	0.002	0.007	0.01	0.011	0.011	0.010	0.012	0.012	0.013	0.015
Cu (HM)	t	1.3280	1.3280	1.3280	1.3280	1.3280	1.3280	0.1159	0.3336	0.4825	0.5551	0.5352	0.5029	0.5695	0.5822	0.6570	0.7205
Pb (HM)	t	0.86	0.86	0.86	0.86	0.86	0.86	0.35	0.22	0.31	0.36	0.38	0.43	0.49	0.45	0.44	0.48
Hg (HM)	t	0.584	0.584	0.584	0.584	0.584	0.584	0.063	0.147	0.212	0.244	0.237	0.225	0.256	0.259	0.289	0.317
Ni (HM)	t	0.029	0.029	0.029	0.029	0.029	0.029	0.033	0.007	0.010	0.012	0.016	0.022	0.026	0.021	0.016	0.017
PCDD/F	g	227.11	183.56	140.01	96.45	52.90	5.99	75.77	1.29	1.60	1.81	11.88	29.89	36.26	22.88	6.73	6.75

Pollutant	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Waste: non-hazardous																	
NMVOC	kt	1.08	1.15	1.22	1.30	1.37	1.22	1.25	1.25	1.25	1.57	1.63	1.37	1.63	1.80	1.78	1.78
NH_3	t	0.05	0.04	0.04	0.05	0.05	0.05	0.08	0.08	0.57	0.70	0.29	3.26	4.93	4.97	4.10	4.12
Other activities																	
SO_x	kt	2.73	2.51	2.90	3.09	2.73	0.21	0.16	0.17	0.04	-	-	-	-	-	-	-
NO_x	kt	0.19	0.17	0.20	0.21	0.19	0.42	0.41	0.40	0.33	0.29	0.27	0.26	0.26	0.26	0.25	0.24
$PM_{2.5}$	kt	2.24	2.17	2.14	2.09	2.03	1.96	1.96	1.84	1.80	1.75	1.70	1.70	1.69	1.64	1.61	1.64
NMVOC	kt	92.55	83.86	85.28	104.93	105.22	78.00	95.21	101.19	91.93	68.35	68.48	70.84	72.09	72.62	68.65	67.37
NH_3	kt	81.46	64.85	61.68	71.97	75.52	80.83	82.16	77.81	75.19	72.24	68.96	68.79	68.13	66.74	65.51	65.60
Cd (HM)	kg	0.07	0.07	0.07	0.07	0.07	0.07	0.09	0.24	0.05	0.14	0.16	0.16	0.18	0.20	0.21	0.21
As (HM)	kg	0.34	0.34	0.34	0.34	0.34	0.34	0.47	1.20	0.27	0.69	0.82	0.79	0.90	1.01	1.05	1.05
Cr (HM)	kg	4.06	4.06	4.06	4.06	4.06	4.06	5.70	14.36	3.20	8.30	9.87	9.45	10.82	12.11	12.55	12.58
Ni (HM)	t	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.12	0.03	0.07	0.08	0.08	0.09	0.10	0.10	0.10
PCDD/F	g	0.04	0.03	0.03	0.02	0.01	-	-	-	-	-	-	-	-	-	-	-

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