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Evaluation of thresholds for capacities and pollutants according to the Protocol on PRTRs

Case-study for the Nordic countries

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Content

Sammanfattning

Utifrån erfarenheter från genomförandet av de nationella PRTR-registren (Pollutant Release and Transfer Register) skall PRTR-protokollets parter överväga att utvärdera tröskelvärdena för kapacitet och föroreningar vilka anges i bilagorna I och II till protokollet (Artikel 6.2). Tröskelvärdena togs fram i syfte att täcka cirka 90 % av de industriella utsläppen i Europa.

Fallstudien för de nordiska länderna syftar till att utvärdera tröskelvärden avseende kapacitet (Annex I) och ämnen (Annex II) enligt PRTR-protokollet. Utvärderingen har baserats på tillgängliga data i ländernas nationella miljörapporteringsdatabaser, Europeiska-PRTR (E-PRTR) och, för utsläpp till luft, även data från CLRTAP (Convention on Long-Range Transboundary Air Pollution). Ett antal ämnen till luft (NO_X, SO_X, NH_3 och PM_{10}) respektive vatten (total-kväve, total-fosfor, Pb och Hg) har inkluderats i analysen.

Vid jämförelse på europeisk nivå för luft, visar resultaten att E-PRTR-data inte fångar 90 % av motsvarande industriella utsläpp enligt CLRTAP för samtliga alla analyserade ämnen. För samtliga ämnen skulle ett avskaffande av tröskelvärden för föroreningar ha en positiv effekt på täckningsgraden i förhållande till CLRTAP. För NH_3 och PM_{10} är skillnaden mellan E-PRTR och CLRTAP dock mycket stor och för dessa ämnen är det inte tillräckligt att avskaffa tröskelvärdena utan det krävs ytterligare åtgärder. För båda ämnena är det tydligt att djurhållning är den aktivitet där skillnaden mellan E-PRTR och CLRTAP är som störst. Detta tyder på att man bör se över PRTR-kapacitetströskeln avseende djurhållning, samt utvärdera beräkningsmetodiken enligt EMEP/EEA Guidebook. För PM_{10} kan man även konstatera att man bör uppdatera bilaga 4 i E-PRTR-vägledningsdokumentet, då PM_{10} ej är inkluderad som ett ämne som förväntas emitteras från djurhållning.

För utsläpp till vatten finns det inget dataset motsvarande CLRTAP, därför var det inte möjligt att jämföra på europeisk nivå. Följaktligen kan jämförelser för vatten endast göras mellan två dataset, data som rapporteras till de nationella miljörapporteringsdatabaserna och till E-PRTR.

Genom att ta bort tröskelvärdet för Pb skulle man fånga 90 % av de rapporterade utsläppen av ämnet i de nationella rapporteringsdatabaserna. För resterande ämnen krävs dock ytterligare åtgärder för att öka täckningsgraden. Avloppsreningsverk och fiskodling är de branscher som identifierats som mest relevanta för granskning av kapacitetströskelvärdena.

Summary

SMED is short for Swedish Environmental Emissions Data, which is a collaboration between IVL Swedish Environmental Research Institute, SCB Statistics Sweden, SLU Swedish University of Agricultural Sciences, and SMHI Swedish Meteorological and Hydrological Institute.

Based on experience gained from the implementation of the national PRTR (Pollutant Release and Transfer Register) registers parties to the Protocol on PRTRs shall consider evaluating the thresholds for capacities and pollutants listed in Annex I and II of the Protocol (Article 6 (2)). The thresholds were set aiming to cover about 90 % of industrial pollution in Europe.

This case study for the Nordic countries aims to evaluate threshold values for capacity (Annex I) and substances (Annex II) according to the Protocol on PRTRs. The evaluation has been based on available data in the countries' national environmental reporting databases, European PRTR (E-PRTR) and, for emissions to air, data from CLRTAP (Convention on Long-Range Transboundary Air Pollution). A number of pollutants to air (NO_X, SO_X, NH_3 and PM_{10}) and to water (total nitrogen, total phosphorus, Pb and Hg) has been included in the analysis.

When comparing at European level for all included air pollutants, the results show that E-PRTR data does not capture 90% of the corresponding industrial emissions according to CLRTAP. For all pollutants, removal of threshold values for pollutants would increase the coverage in relation to CLRTAP. However, for NH_3 and PM_{10}, the difference between E-PRTR data and CLRTAP data is very large and additional measures are required. For both pollutants is it obvious that livestock is the activity where the difference between E-PRTR and CLRTAP is the largest. This indicates that the PRTR capacity threshold for livestock should be reviewed and that there is a need to evaluate the calculation methodology of the EMEP/EEA Guidebook. For PM_{10}, it can also be noted that Annex 4 of the E-PRTR guidance document should be updated, as PM_{10} is not included since it is not expected to be emitted from livestock.

For emissions to water, no dataset corresponding to CLRTAP exists, therefore any comparison on European level could not be made. Consequently, comparisons for water can only be made between two datasets, data reported to the national environmental reporting databases and to E-PRTR. For Pb, removing the threshold is enough to capture 90% of the reported emissions in the national reporting databases. For the remaining substances, however, additional measures are required to increase the

coverage in relation to the national databases. Wastewater treatment plants and aquaculture are the industries that have been identified as the most relevant for a review of the capacity thresholds.

Keywords

PRTR, pollutant thresholds, capacity thresholds, CLRTAP, Nordic countries.

Introduction

In October 2009, the Kiev Protocol on Pollutant Release and Transfer Register (Protocol on PRTRs) entered into force. The Protocol was drawn up to fulfill the Aarhus Convention provision that each Party shall establish a register on releases and transfers of pollutants, in order to enable public participation in policy making concerning environmental issues, and to contribute to the prevention and reduction of environmental pollution.

Today 36 parties, including the EU and all Nordic countries except Iceland, have ratified the protocol.[1] The Protocol is regulated by the following documents:

- Protocol on Pollutant Release and Transfer Registers
- Guidance to Implementation of the Protocol on PRTRs

The activities listed in Annex I to the IPPC Directive (precursor to the EU Industrial Emissions Directive) were used in the Protocol, mainly due to the practical reason that many UNECE countries already were or were to become members of the EU, and thus already had systems in place to control polluting emissions from the facilities carrying out these activities. A second reason was that these activities, together with the additional ones in the Protocol, were responsible for about 90 % of industrial pollution.[2] Thus, information on releases from the facilities carrying out Annex I activities should provide the public with a good overall picture of the level of pollution from its industrial installations. Other activities can be added at national level if the Party considers it appropriate. The Protocol covers 64 different economic activities grouped into nine different sectors:

1. Energy
2. Production and processing of metals
3. Mineral industry
4. Chemical industry
5. Waste and waste water management
6. Paper and wood production and processing
7. Intensive livestock production and aquaculture
8. Animal and vegetable products from the food and beverage sector
9. Other activities

Annex I to the Protocol includes two different approaches to identify facilities to be reported, either capacity thresholds or employee thresholds.

[1] https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-13-a&chapter=27&clang=_en#bottom

[2] https://www.unece.org/fileadmin/DAM/env/pp/prtr/guidance/PRTR_May_2008_for_CD.pdf

Annex II to the Protocol on PRTRs lists 86 different pollutants. The pollutants are divided into different categories such as greenhouse gases, ozone-depleting substances, heavy metals, pesticides, acidification precursors and persistent organic compounds. Lists of substances regulated by several international agreements have been used to develop Annex II, including:

- United Nations Framework Convention on Climate Change (UNFCCC)
- Commission decision 2000/479/EC on the implementation of a European Pollutant Emission Register (EPER) according to Article 15 of Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC)
- The EU Water Framework Directive
- The Stockholm Convention on POPs
- The Rotterdam Convention
- Convention on Long-range Transboundary Air Pollution (CLRTAP)
- Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)
- The International Convention for the Prevention of Pollution for ships (MARPOL)

The register shall cover releases to air, water, land, off-site transfers of pollutants through wastewater and off-site transfers of waste. For waste transfers, the Protocol provides two different approaches to define the threshold above which waste transfers must be reported; total amounts of waste transferred, or total amounts of a specific pollutant transferred in the waste. For each pollutant and waste given in Annex II to the PRTR a threshold is set and if the applicable threshold is exceeded the amount of the pollutant must be reported per facility. The threshold values for discharges to water also apply to off-site transfers of pollutants in waste water to be purified. The Parties may include additional pollutants and lower thresholds if they wish.

In accordance with Article 6 (2), based on the experience gained from the implementation of the national PRTR registers, parties shall consider evaluating the thresholds for capacities and pollutants listed in Annex I and II of the Protocol.

The Nordic PRTR Group discussed how thresholds are being used in their national reporting at their meeting in spring 2018, and it was agreed that it would be valuable to evaluate the thresholds listed in Annex I and Annex II of the Protocol.

Aim

The overall aim of this project is to evaluate the thresholds for capacities (Annex I) and pollutants (Annex II) according to the Protocol on PRTRs. The evaluation is based on information on emissions for the Nordic countries, available in their national environmental databases, national PRTRs, E-PRTR (European PRTR) and, for air, CLRTAP (Convention on Long-Range Transboundary Air Pollution). The compiled material could serve as support for future discussions linked to further development of the Protocol on PRTRs, which is currently ongoing.

Method

Data sources

Three different datasets have been compiled and used as a basis for the analysis within the project:

- Point source data available in the national environmental data reporting systems:
    - Denmark, Iceland and Sweden for 2014-2016
    - Norway for 2015-2016
- Point source data available in the E-PRTR:
    - EU-28 + Norway and Iceland (2014-2016)
- Data reported to the Air Pollution Convention (CLRTAP):
    - EU-28 + Norway and Iceland (2014-2016)

National environmental reporting systems

The Nordic countries have chosen to implement the thresholds for pollutants listed in Annex II in different ways (see Appendix 1).

Norway collects data on releases for all facilities with permits and emissions of environmental importance. Norway does not apply any thresholds for pollutants.

Sweden collects data on releases for E-PRTR Annex I activities, large combustion plants (LCPs) and waste water treatment plants (WWTPs). Sweden applies thresholds according to the PRTR protocol (or E-PRTR) for some pollutants and for other pollutants lower thresholds are set.

Since 2015, Denmark collects data for facilities with activities according to Annex I and pollutant thresholds according to Annex II. Before 2015, Denmark included releases with lower thresholds than given in Annex II.

Iceland collects data for facilities with activities according to Annex I and pollutant thresholds according to Annex II.

E-PRTR

On EU level the Protocol on PRTRs has been implemented through the European register (E-PRTR). E-PRTR is regulated by the following documents:

- Regulation (EC) No 166/2006 of the European Parliament and of the Council[3]
- Guidance Document for the implementation of the European PRTR[4]

The thresholds have been set with the intention of covering, for each specific pollutant, about 90 % of the total mass emissions from facilities regulated under E-PRTR.[5] In the guidance document for EPER (precursor of E-PRTR) implementation it is stated that the purpose for applying thresholds for pollutants was to avoid the need for the industry to report insignificant emissions while, at the same time, the reporting will cover at least 90 % of total industrial emissions in Europe. The actual figures proposed as threshold values are based on available data from the Netherlands, Germany and the United Kingdom (England and Wales) as well as on the opinions expressed by various Member States.[6] The E-PRTR Regulation goes beyond the PRTR Protocol by requiring the reporting on five additional pollutants[7] and more stringent thresholds for six pollutants[8].

E-PRTR data for 2014-2016 have been downloaded from the EEA's webpage[9].

CLRTAP

CLRTAP (Convention on Long-Range Transboundary Air Pollution) is currently covered by eight different protocols.[10] The emission inventory under the convention covers national total emission and data are reported on an annual basis by Parties in a given format, i.e. the Nomenclature For Reporting (NFR). Data for 2014-2016 have been downloaded from WebDab[11].

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[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R0166&from=EN
[4] https://prtr.eea.europa.eu/#/downloadguidance
[5] https://prtr.eea.europa.eu/#/faq
[6] https://www.rcsk.sk/mix/gd_eper.pdf
[7] Octylphenols and Octylphenol ethoxylates, Fluoranthene, Isodrin, Hexabromobiphenyl and Benzo(g,h,i)perylene
[8] PCDD (dioxins) + PCDF (furans), tetrachloroethylene, tetrachloromethane, trichlorobenzene, trichloroethylene and trichloromethane
[9] https://www.eea.europa.eu/data-and-maps/data/member-states-reporting-art-7-under-the-european-pollutant-release-and-transfer-register-e-prtr-regulation-21
[10] https://www.unece.org/env/lrtap/status/lrtap_s.html
[11] http://webdab1.umweltbundesamt.at/official_country_year.html?cgiproxy_skip=1

It is important to be aware of that industrial emissions according to CLRTAP are separated between process- and energy-related emissions. As an example, energy-related emissions from the chemical industry are reported in NFR 1A2c, while process emissions are reported in NFR 2B.

Mapping table

A team of Finnish and Estonian emission experts have created a mapping table linking categories of different reporting formats (for example NFR14, and E-PRTR) that is available at CEIP's webpage.[12] Based on this table a mapping table between NFR-codes and PRTR-sectors for industries has been created (see Appendix 1). The mapping table has been used to compare the reported emissions under CLRTAP and E-PRTR for industries and to find out whether the E-PRTR covers 90 % of the total industrial emissions in Europe according to CLRTAP. Livestock according to PRTR includes only poultry and pigs/swine emissions from stables and other buildings, therefore only the corresponding NFR-codes have been included in the comparison.

Selection of pollutants

Based on the amount and quality of data available in the national environmental databases and the possibility of comparison with pollutants that are covered by CLRTAP, the following pollutants to air have been included in the study:

- NO_X
- SO_X (as SO_2)
- NH_3
- PM_{10}[13]

For water the following pollutants have been selected:

- Total nitrogen
- Total phosphorus
- Hg
- Pb

The thresholds for the selected pollutants are identical in both E-PRTR and the Protocol (see Appendix 2).

[12] http://www.ceip.at/ms/ceip_home1/ceip_home/reporting_instructions/

[13] If an operator has not reported PM_{10} but TSP (total suspended particles), TSP has been used as PM_{10} with a factor 1.

Limitations

Due to limited resources and time restrictions, Finland could not deliver data available in the national environmental reporting system. Consequently, Finland has not been included in the analysis on national level.

Reported air emissions to CLRTAP are intended to represent total national emissions and various data sources and methods are used. One common method of estimating emissions is to calculate these based on activity data and emission factors, which means that reported emissions are associated with uncertainties.

The mapping between PRTR and CLRTAP is not perfect since PRTR corresponds to total emissions for a facility while CLRTAP splits the facilities emissions between process and energy.

For emissions to water, no dataset exists corresponding to CLRTAP, therefore any comparison on European level could not be made.

Results and discussion

Air

The thresholds, according to Annex II and the national legislation for the countries, for the selected air pollutants are presented in Table 1. The table shows that Denmark and Iceland use thresholds according to Annex II, while Sweden uses much lower thresholds for NO_X and NH_3, and Norway does not apply any thresholds at all.

Table 1. NO_X, SO_X, NH_3 and PM_{10} thresholds (kg) in Annex II (PRTR protocol and the E-PRTR regulation) compared to thresholds in national environmental data reporting systems for Sweden, Norway, Denmark and Iceland

Pollutant	Annex II	Sweden	Norway	Denmark[1]	Iceland
Nitrogen oxides (NO_X/NO_2)	50 000	6 000[2)]	0	50 000	50 000
Sulphur oxides (SO_X/SO_2)	150 000	150 000[2)]	0	150 000	150 000
Ammonia (NH_3)	10 000	1 000	0	10 000	10 000
Particulate matter (PM10)	50 000	50 000	0	50 000	50 000

1) - before 2015 Denmark´s national thresholds for NO_X, SO_X, NH_3 and PM_{10} were lower than those of the EPRTR/PRTR.

2) For large combustion plants (LCPs) no threshold is applied.

Comparison at European level

In Figure 1 (NO_X), Figure 2 (SO_X), Figure 3 (NH_3) and Figure 4 (PM_{10}), comparison between CLRTAP and E-PRTR data per industry sector at European level (EU-28 + Norway and Iceland) for 2014 to 2016 are presented. The figures show that the coverage of 90 % of the total industrial emissions at European level according to CLRTAP is not reached for any of the studied pollutants. It should be noted that the emissions from waste incineration in E-PRTR is mainly included in the energy sector in CLRTAP and that CLRTAP does not include emissions from aquaculture (see Appendix 2).

However, the coverage of E-PRTR data compared to CLRTAP data is quite good for NO_X (approximately 80 %) and SO_X (approximately 70-80 %) at the European level. This is mainly because these pollutants have been regulated for many years in Europe and therefore the knowledge of and data on the emissions is substantial. The emissions of NO_X (see Figure 1) and SO_X (see Figure 2) originating from the mineral industry and the chemical industry are lower in E-PRTR compared to CLRTAP. The results could

indicate that the thresholds for NO_X and SO_X according to PRTR are too high.

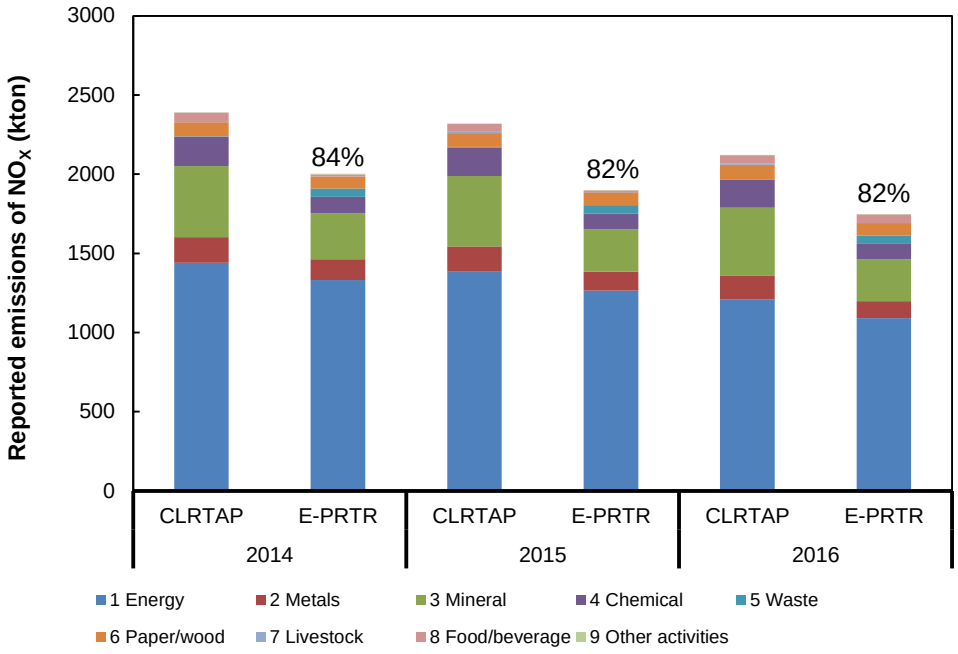

Figure 1. Comparison between reported emissions of NO_X (kton) according to CLRTAP and E-PRTR for 2014-2016.

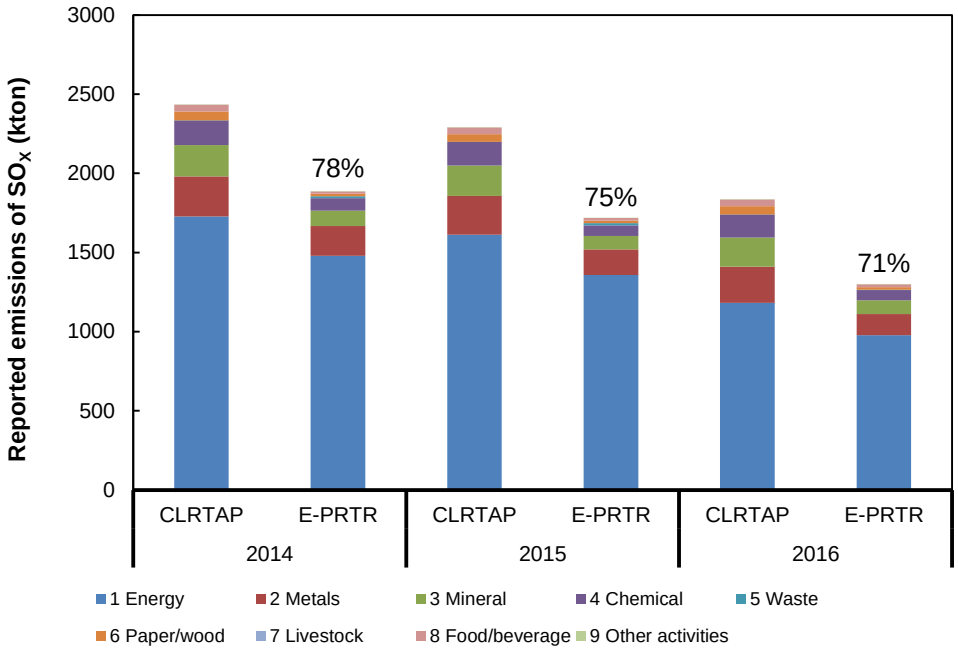

Figure 2. Comparison between reported emissions of SO_X (kton) according to CLRTAP and E-PRTR for 2014-2016.

The reported emissions of NH_3 to E-PRTR correspond to approximately 25-30 % of the reported emissions according to CLRTAP data at the European level (see Figure 3). Emissions from the livestock industry are significantly higher in the estimates for CLRTAP compared to E-PRTR. The same relationship also applies to the chemical industry, even though emissions are much lower for this industry. This could indicate that the capacity thresholds for the livestock industry or thresholds for NH_3 according to PRTR are too high, or that the methodologies used to estimate emissions for the reporting to CLRTAP tend overestimate emissions.[14]

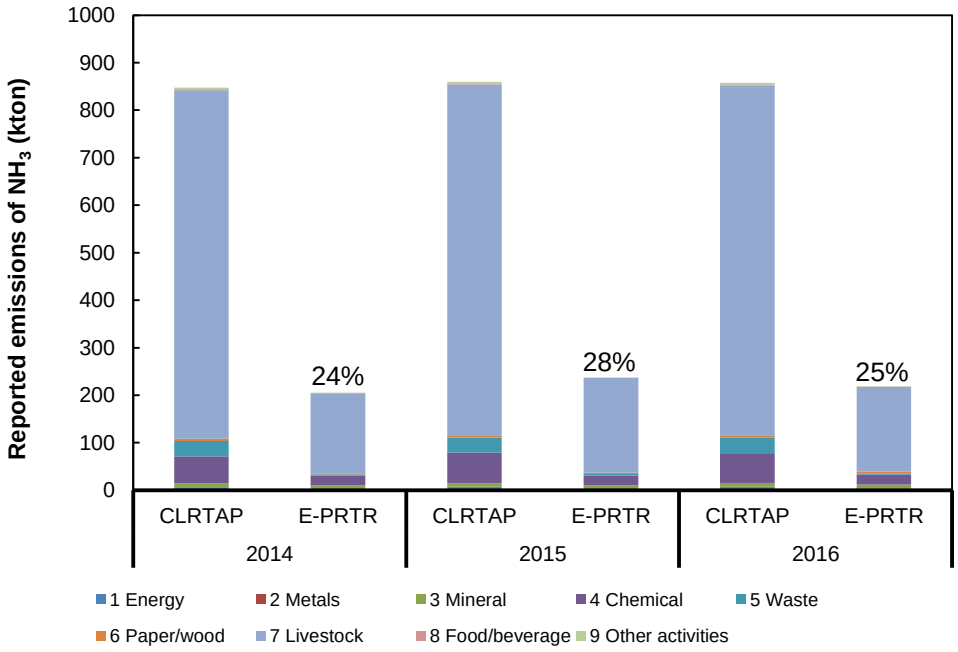

Figure 3. Comparison between reported emissions of NH_3 (kton) according to CLRTAP and E-PRTR for 2014-2016.

[14] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/4-agriculture/3-b-manure-management-2016/view

The reported emissions of PM_{10} in E-PRTR correspond to approximately 15-20 % of the reported emissions according to CLRTAP data at the European level (see Figure 4). The reported emissions of PM_{10} in E-PRTR are much lower for all sectors compared to CLRTAP. This could indicate that either the threshold for the pollutant is too high in E-PRTR, or that the methodologies used to estimate PM_{10} emissions for the reporting to CLRTAP tend to overestimate the emissions.[15] Another possible reason for the discrepancy could be the fact that, according to the indicative sector specific sub-list of air pollutants given in the E-PRTR guidelines (Appendix 4), PM_{10} is not expected from livestock while in EMEP/EEA guidebook it is included.

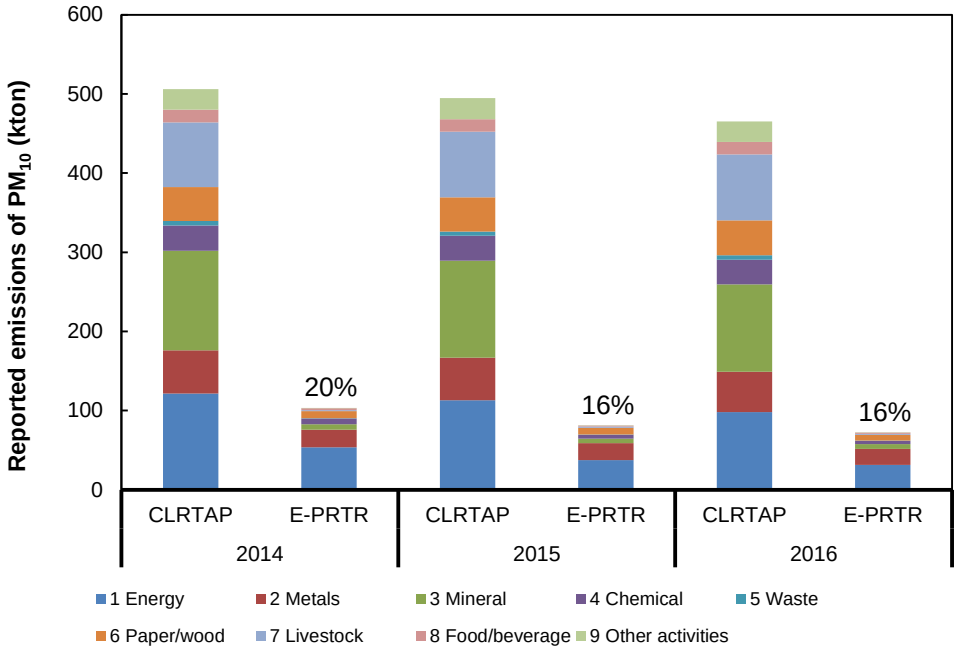

Figure 4. Comparison between reported emissions of PM_{10} (kton) according to CLRTAP and E-PRTR for 2014-2016.

Comparison at country level per pollutant

Data reported to CLRTAP, E-PRTR and the national environmental reporting databases have been compiled for NO_X, SO_X, NH_3 and PM_{10} for all countries included in the study. Data reported to the national environmental databases are presented in the figures below in two different categories; "All PRTR" (including Annex I facilities within the national database) and "All facilities" (including all facilities available in the national database). Within this project, data from the Norwegian environmental reporting database is not available for 2014.

[15] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/4-agriculture/3-b-manure-management-2016/view

NO_X

For Norway, the correlation between the reported emissions of NO_X to CLRTAP, E-PRTR and the national database is very good and the emissions available in both E-PRTR and the national database are approximately 90 % of the emissions reported to CLRTAP (see Figure 5). The mineral industry is the dominating source of NO_X in Norway and emissions from the chemical industry are consistent in all three datasets.

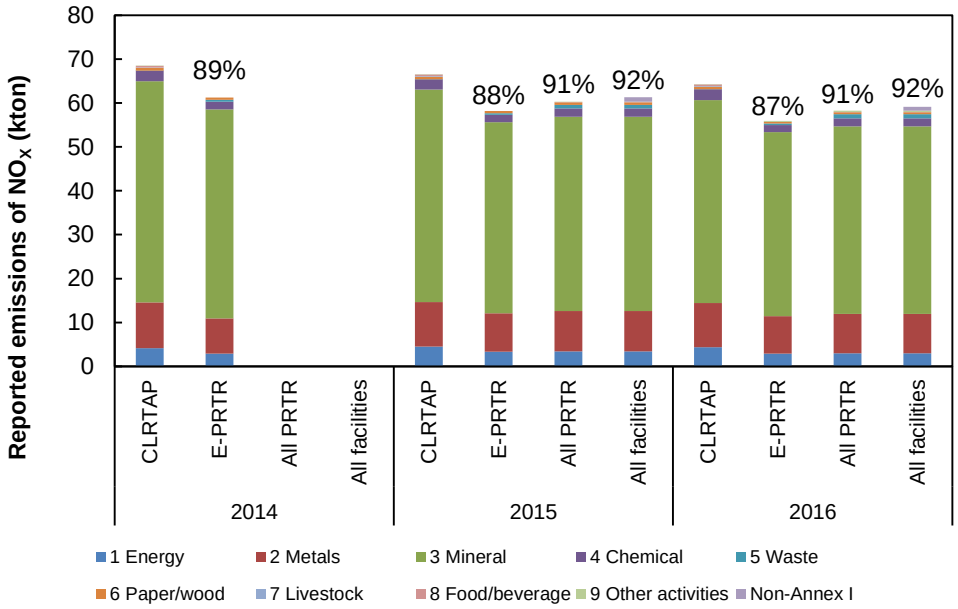

Figure 5. Comparison between Norway's reported emissions of NO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The emissions of NO_X from Swedish E-PRTR facilities correspond to approximately 71-78 % of the emissions reported to CLRTAP (see Figure 6). The NO_X emissions available in the national database (both "All PRTR" and "All facilities") correspond to more than 90 % of CLRTAP emissions. The dominating source of NO_X emissions in Sweden is the pulp and paper industry. It can also be seen that the reported emissions from the chemical industry are lower in E-PRTR compared to CLRTAP and to the national database.

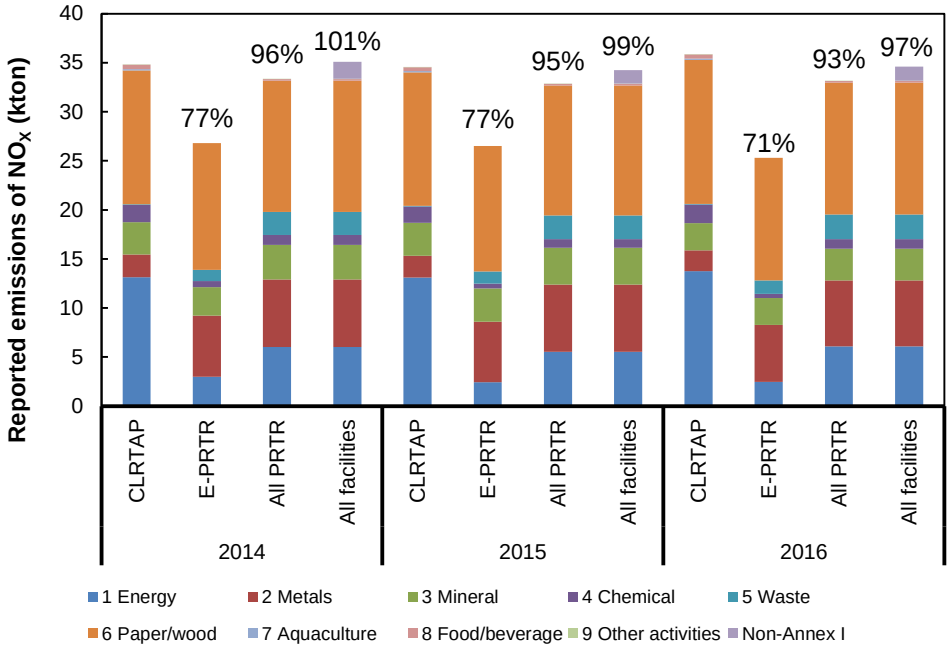

Figure 6. Comparison between Sweden's reported emissions of NO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

For Denmark, the reported emissions of NO_X to E-PRTR correspond to 62-70 % of the emissions reported to CLRTAP (see Figure 7). The NO_X emissions available in the national database for 2014 (both "All PRTR" and "All facilities") correspond to approximately 80 % of CLRTAP emissions. As mentioned above (see section National environmental reporting systems) Denmark changed the national reporting requirements to be identical with the requirements according to E-PRTR. The dominating source of NO_X emissions in Denmark is the energy industry. The emissions of NO_X from both the mineral and chemical industry are lower in E-PRTR compared to CLRTAP.

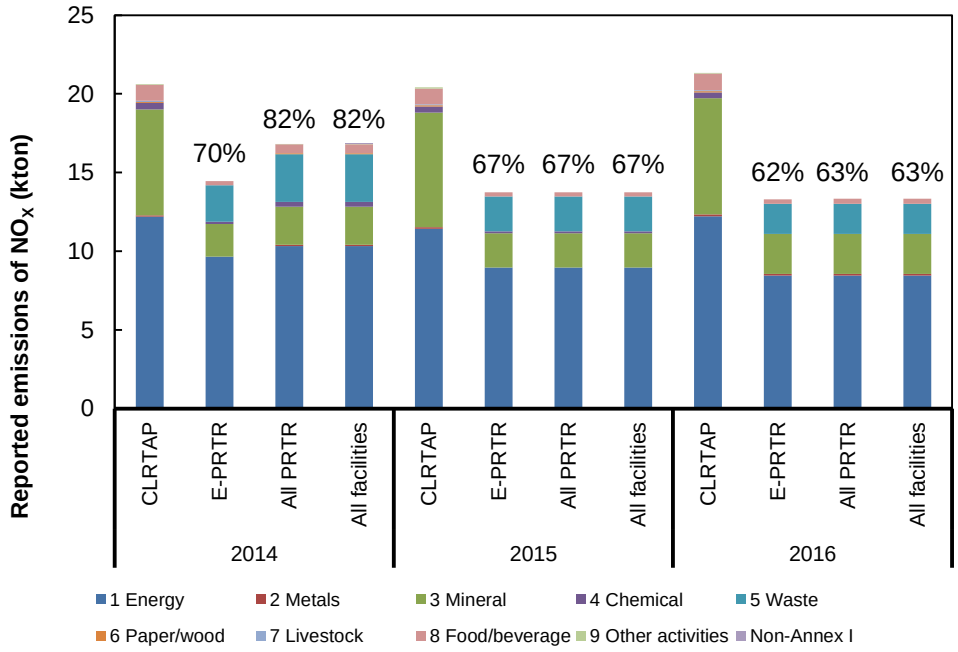

Figure 7. Comparison between Denmark's reported emissions of NO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

For Iceland, no emissions of NO_X are reported to E-PRTR while emissions from the metal industry are included in the national reporting to CLRTAP (see Figure 8).

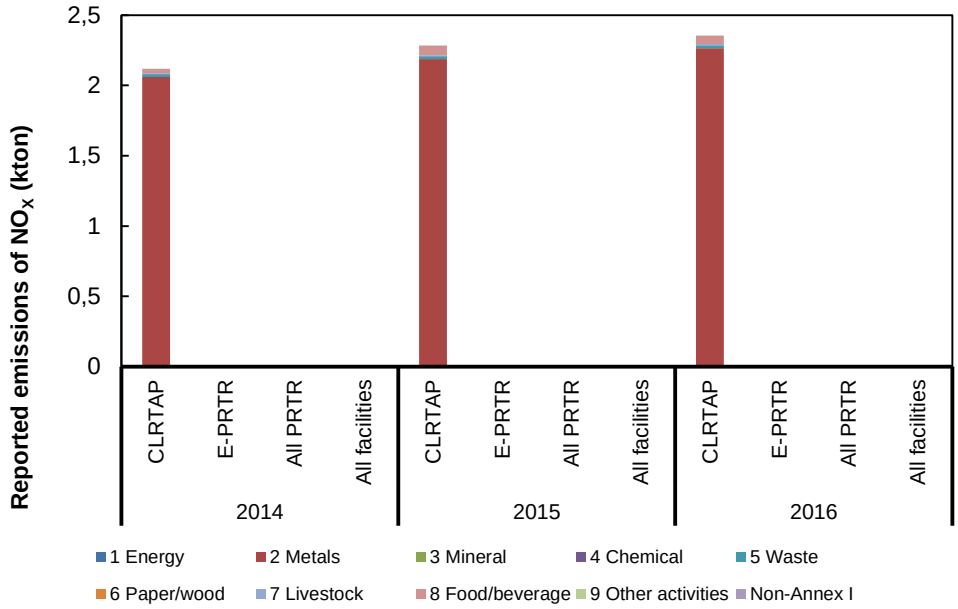

Figure 8. Comparison between Iceland's reported emissions of NO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

SO_X

The emissions of SO_X from Norwegian E-PRTR facilities correspond to approximately 70 % of the emissions reported to CLRTAP (see Figure 9). The SO_X emissions available in the national database for PRTR facilities correspond to more than 80 % of CLRTAP emissions. The metal industry is the dominating source of SO_X in Norway.

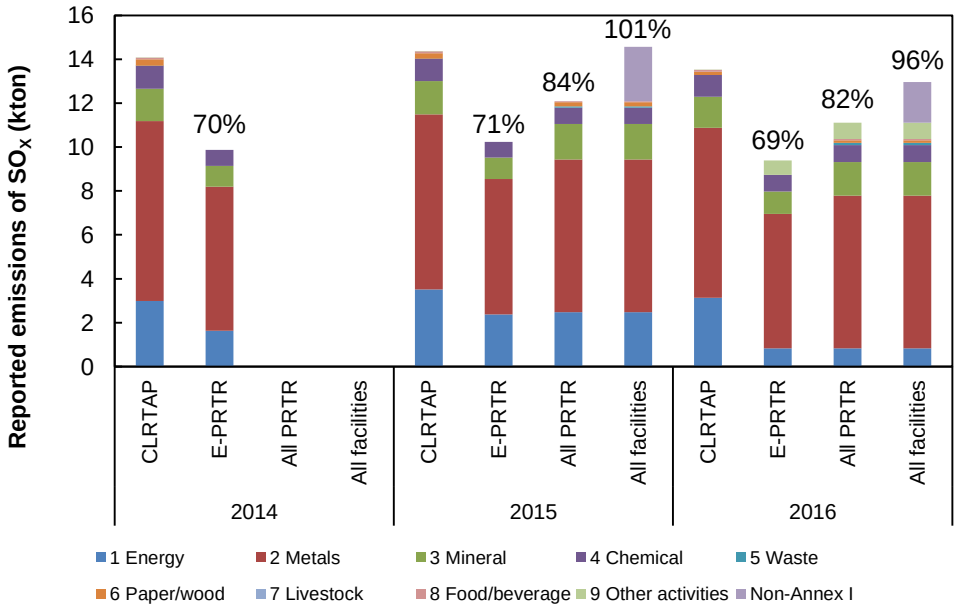

Figure 9. Comparison between Norway's reported emissions of SO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The emissions of SO_X from Swedish E-PRTR facilities correspond to 58-65 % of the emissions reported to CLRTAP (see Figure 10). The SO_X emissions available in the national database (both "All PRTR" and "All facilities") correspond to approximately 80 % of CLRTAP emissions. The dominating sources of SO_X emissions in Sweden are the metal industry and the pulp and paper industry. It can also be seen that the reported emissions from the chemical and mineral industry are lower both in E-PRTR and the national database compared to CLRTAP.

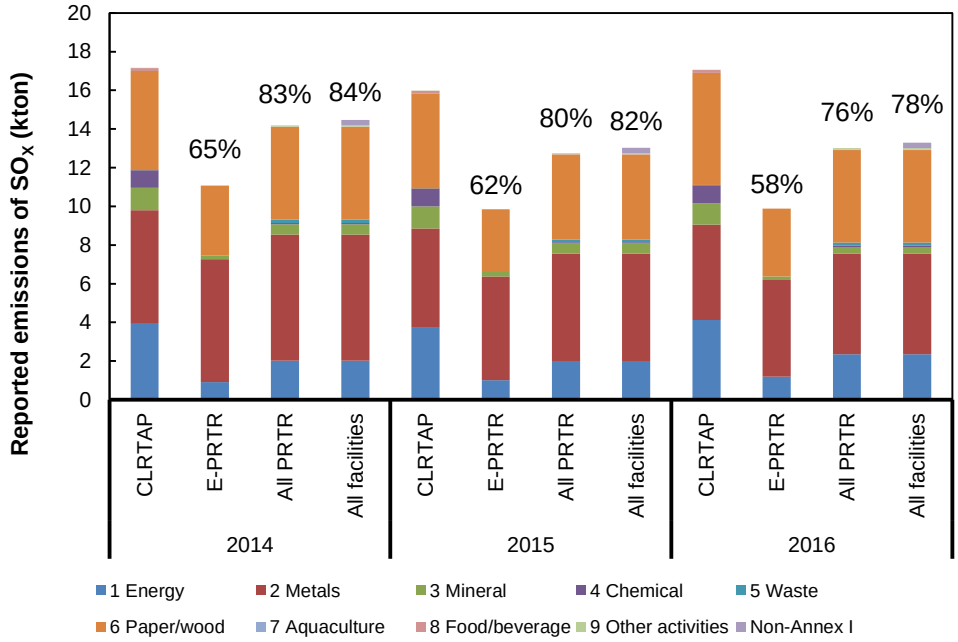

Figure 10. Comparison between Sweden's reported emissions of SO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The emissions of SO_X from Danish E-PRTR facilities correspond to 35-65 % of the emissions reported to CLRTAP (see Figure 11). The SO_X emissions available in the national database for 2014 (both "All PRTR" and "All facilities") correspond to 87 % of CLRTAP emissions. As mentioned above (see section National environmental reporting systems) Denmark changed the national reporting requirements to be identical with the requirements according to E-PRTR. The dominating sources of SO_X emissions in Denmark are the energy industry and the mineral industry. For 2015 and 2016 it shows that the reported emissions from both industries are lower in E-PRTR and the national database compared to CLRTAP.

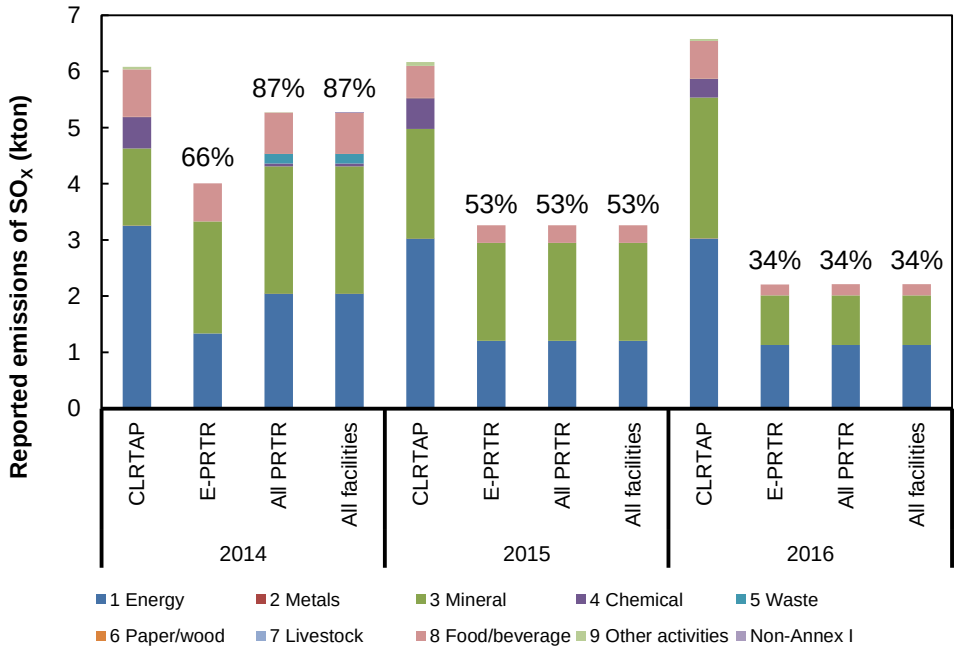

Figure 11. Comparison between Denmark's reported emissions of SO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

For Iceland, the correlation between the reported emissions of SO_X to CLRTAP, E-PRTR and the national database is very good and the emissions available in both E-PRTR and the national database are 80-90 % of the emissions according to CLRTAP (see Figure 12). The metal industry is the dominating and only industry source of SO_X in Iceland.

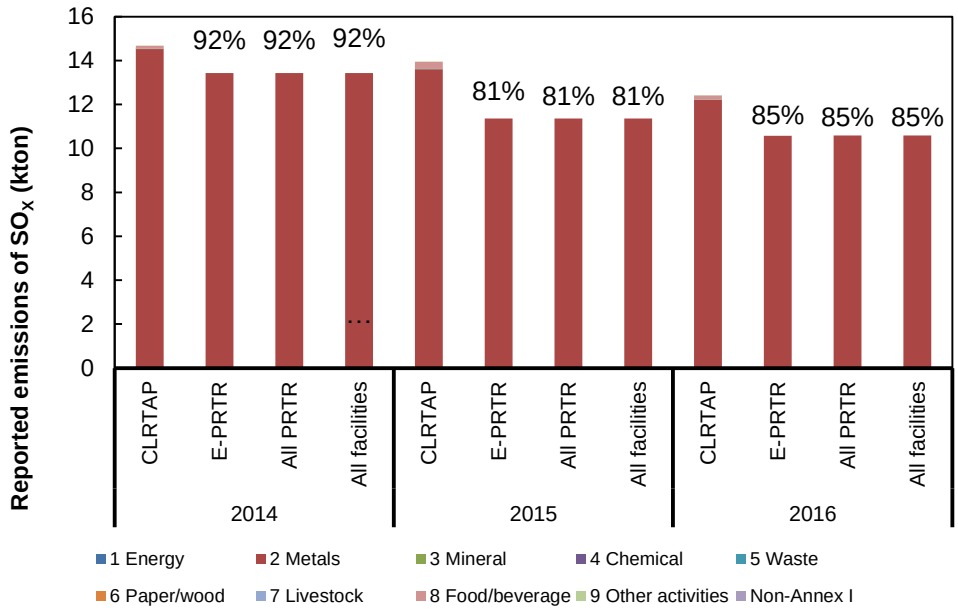

Figure 12. Comparison between Iceland's reported emissions of SO_X (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

NH_3

The Norwegian emissions of NH_3 available in E-PRTR and in the national database correspond to 20-23 % of the emissions reported to CLRTAP (see Figure 13). The dominating source of NH_3 emissions according to CLRTAP is livestock, while this source is neither included in E-PRTR for Norway, nor in the national environmental database. The inconsistency between the two reporting obligations needs to be investigated further by the country.

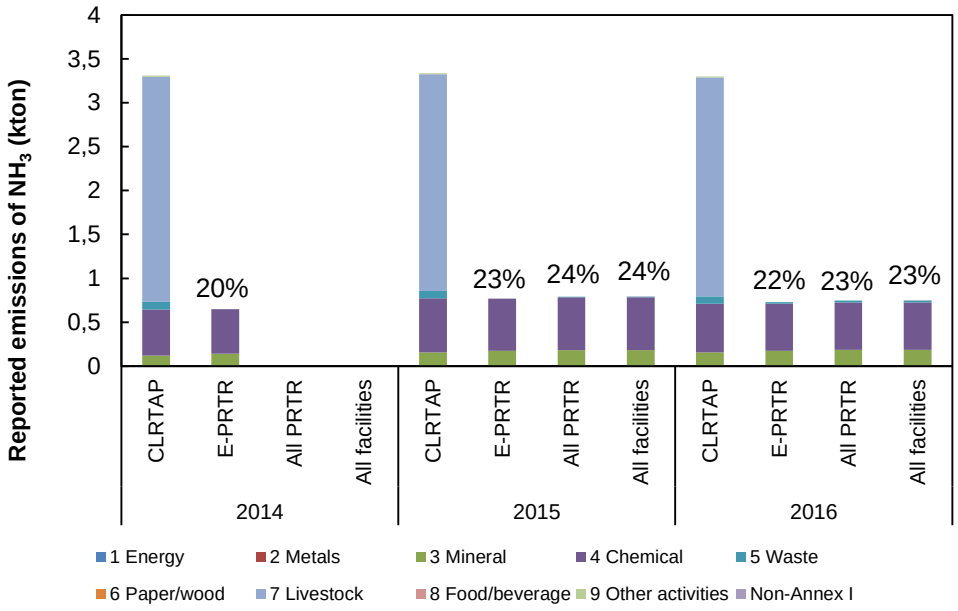

Figure 13. Comparison between Norway's reported emissions of NH_3 (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The Swedish emissions of NH_3 available in E-PRTR correspond to approximately 45 % of the emissions reported to CLRTAP (see Figure 14). The reported emissions of NH_3 in the national database correspond to approximately 65 % of the CLRTAP emissions. The dominating source of NH_3 emissions according to CLRTAP is livestock followed by pulp and paper. Data for both industries available in E-PRTR and the national database follows this pattern, but the releases from especially livestock is much lower compared to CLRTAP.

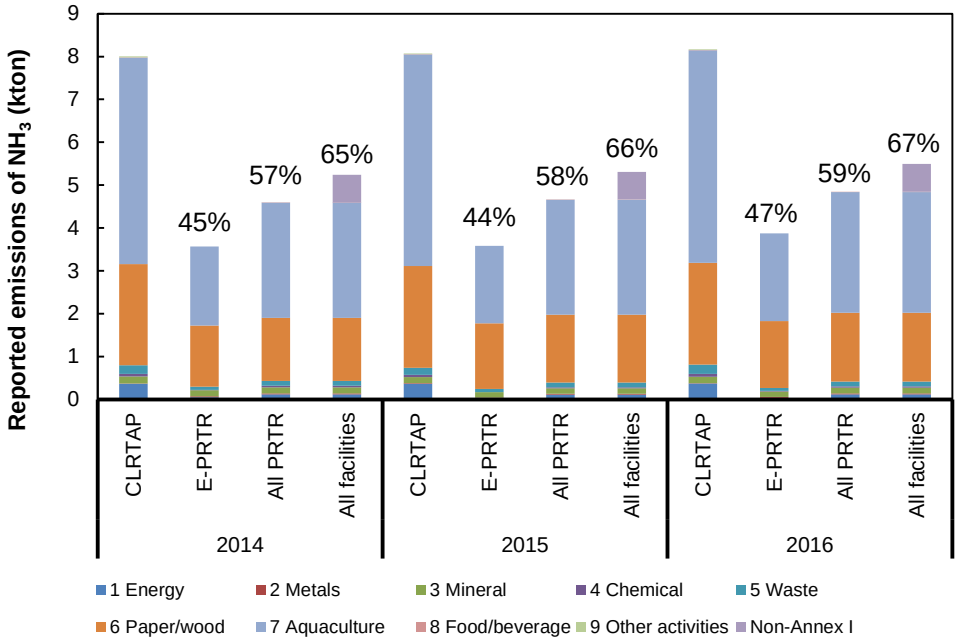

Figure 14. Comparison between Sweden's reported emissions of NH_3 (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The Danish emissions of NH_3 available in E-PRTR and in the national database are below 10 % of CLRTAP emissions (see Figure 15). The dominating source of NH_3 emissions according to CLRTAP is livestock, while this source is minor in E-PRTR and in the national environmental database for Denmark.

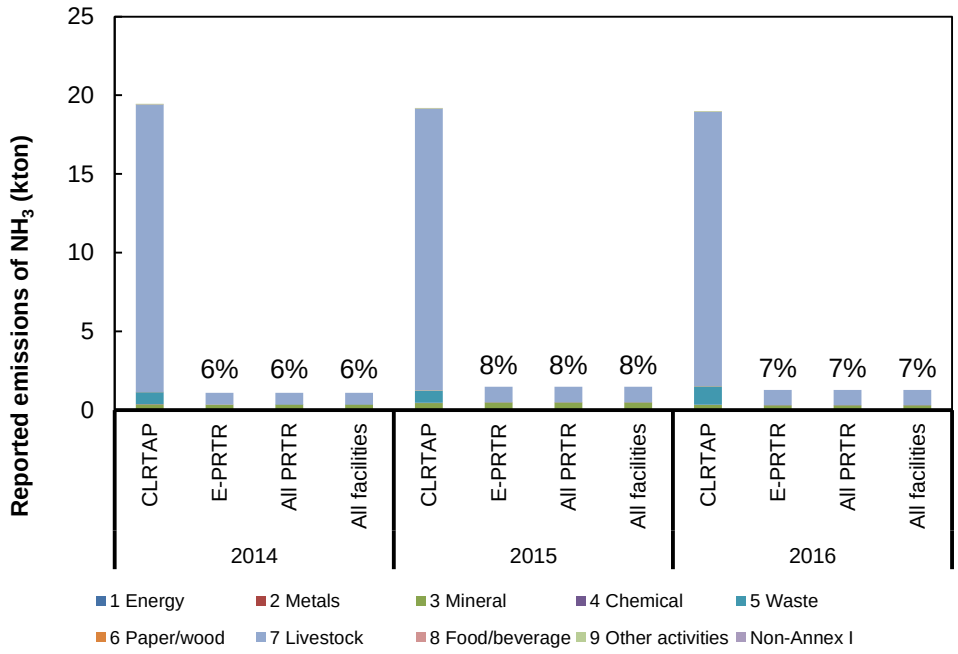

Figure 15. Comparison between Denmark's reported emissions of NH_3 (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The Icelandic emissions of NH_3 available in E-PRTR and in the national database correspond to approximately 50 % of the emissions reported to CLRTAP (see Figure 16). Livestock is the dominating source of NH_3 emissions according to CLRTAP, E-PRTR and the national database, but the reported releases in E-PRTR and the national database are much lower compared to CLRTAP.

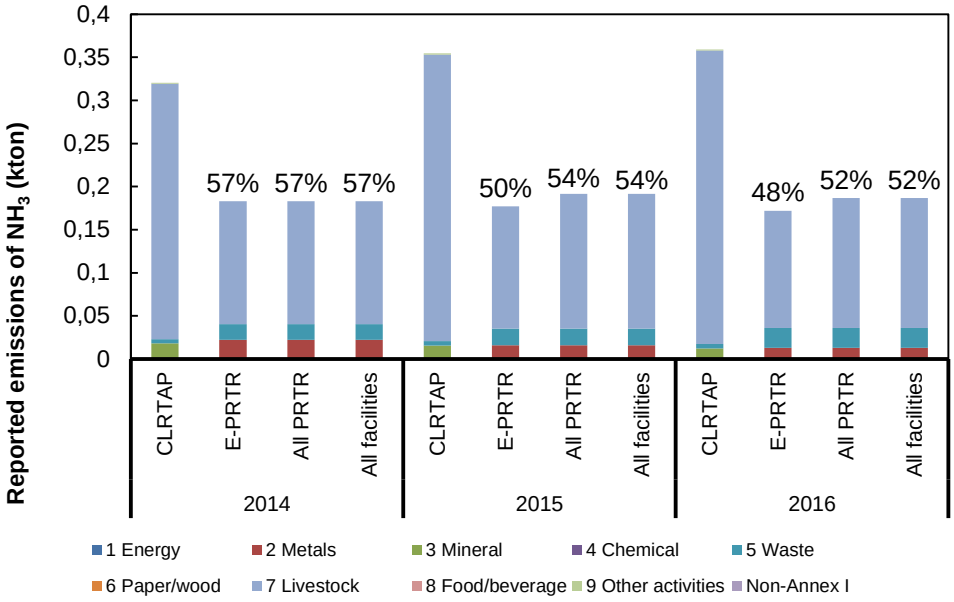

Figure 16. Comparison between Iceland's reported emissions of NH_3 (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

PM_{10}

The emissions of PM_{10} from Norwegian E-PRTR facilities correspond to approximately 30 % of the emissions reported to CLRTAP (see Figure 17). The PM_{10} emissions available in the national database for PRTR facilities correspond to approximately 40 % of CLRTAP emissions. The mineral and metal industry are the dominating sources of PM_{10} in Norway according to CLRTAP. Emissions from the mineral industry are not included in the dataset for E-PRTR and is minor in the national database. The contribution from the metal industry is approximately at the same level in all three available datasets for Norway.

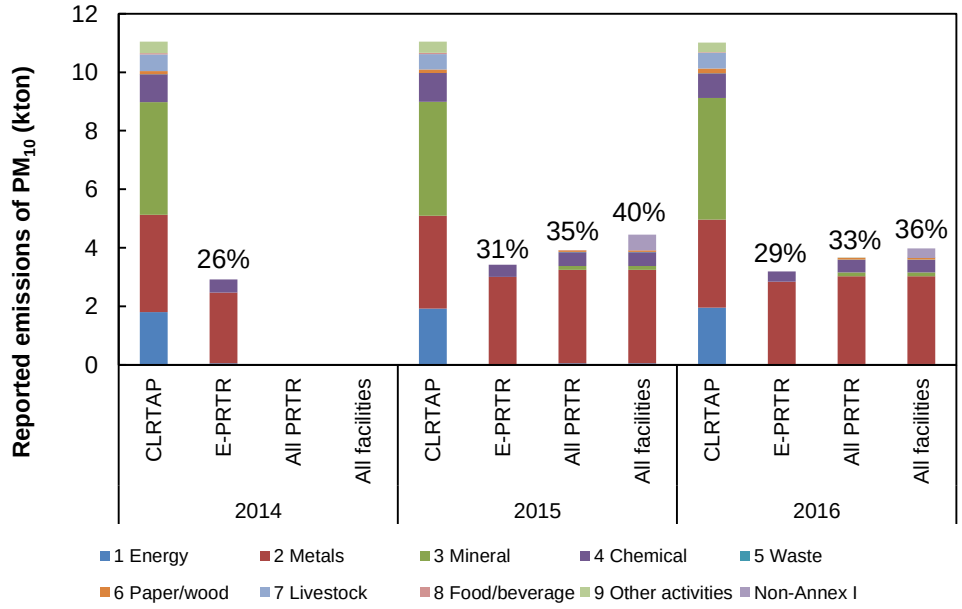

Figure 17. Comparison between Norway's reported emissions of PM_{10} (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The emissions of PM_{10} from Swedish E-PRTR facilities correspond to approximately 45 % of the emissions reported to CLRTAP (see Figure 18). The PM_{10} emissions available in the national database for PRTR facilities correspond to about 50 % of CLRTAP emissions. The pulp and paper industry and livestock are the dominating sources of PM_{10} in Sweden according to CLRTAP, but livestock is not included in the dataset for E-PRTR. According to the indicative sector specific sub-list of air pollutants given in the E-PRTR guidelines (Appendix 4), PM_{10} is not expected from livestock, while in EMEP/EEA guidebook it is included.[16] The contribution from pulp and paper is approximately at the same level in all three available datasets for Sweden.

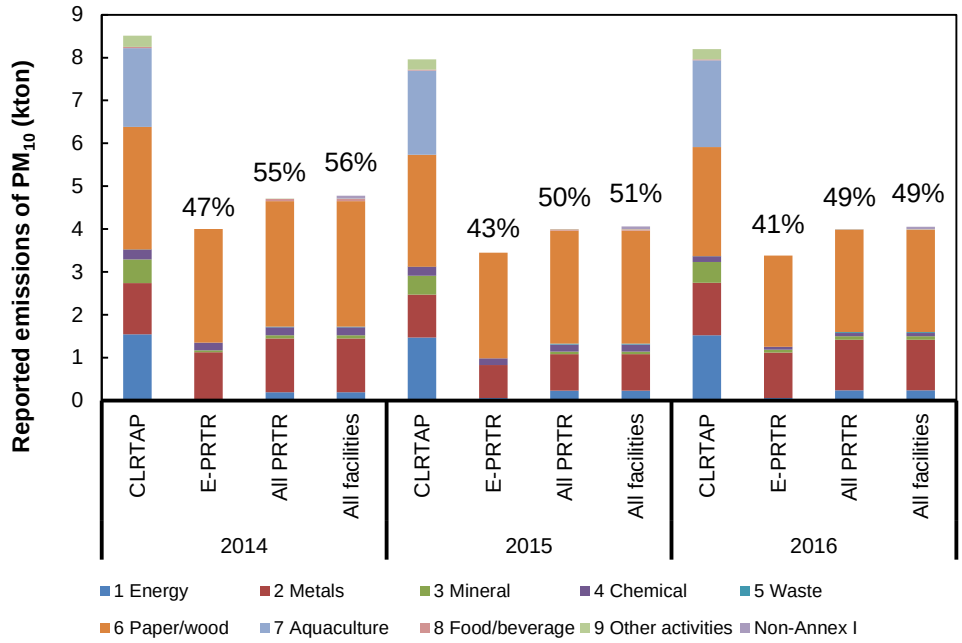

Figure 18. Comparison between Sweden's reported emissions of PM_{10} (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

[16] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/4-agriculture/3-b-manure-management-2016/view

The emissions of PM_{10} from Danish E-PRTR facilities correspond to 4-12 % of the emissions reported to CLRTAP (see Figure 19). The mineral industry and livestock are the dominating sources of PM_{10} in Denmark according to CLRTAP. However, livestock is not included in the dataset for E-PRTR, probably due to that it is not expected according to the E-PRTR guidelines (Appendix 4). The contribution from the mineral industry is much lower in E-PRTR and in the national database for Denmark.

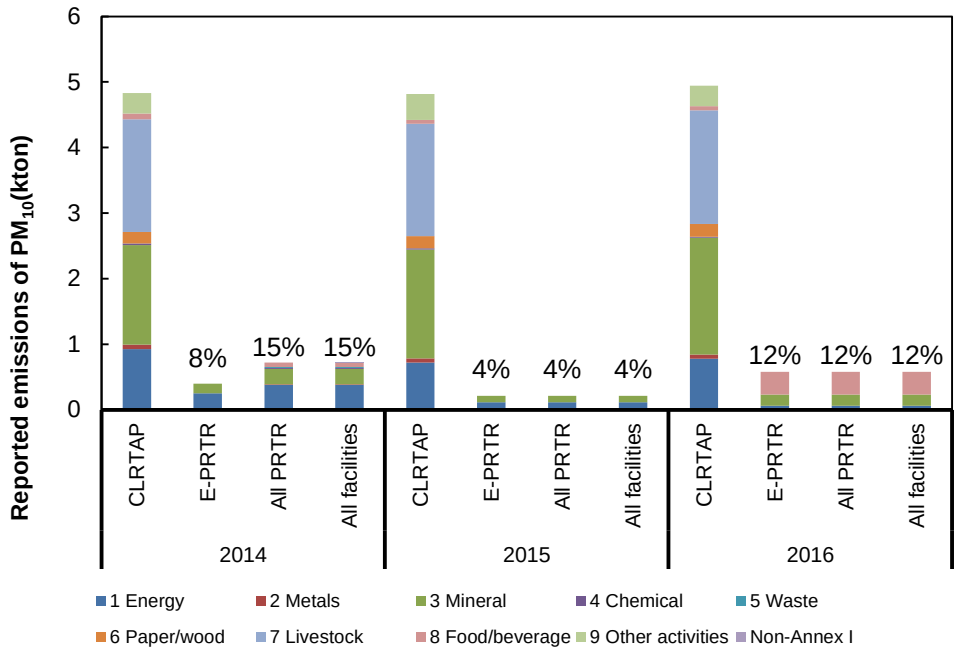

Figure 19. Comparison between Denmark's reported emissions of PM_{10} (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014-2016.

The Icelandic emissions of PM_{10} available in E-PRTR and in the national database correspond to approximately 50 % of the emissions reported to CLRTAP (see Figure 20). According to all three datasets the dominating source of PM_{10} emissions is the metal industry, but the reported releases in E-PRTR and the national database are lower compared to CLRTAP.

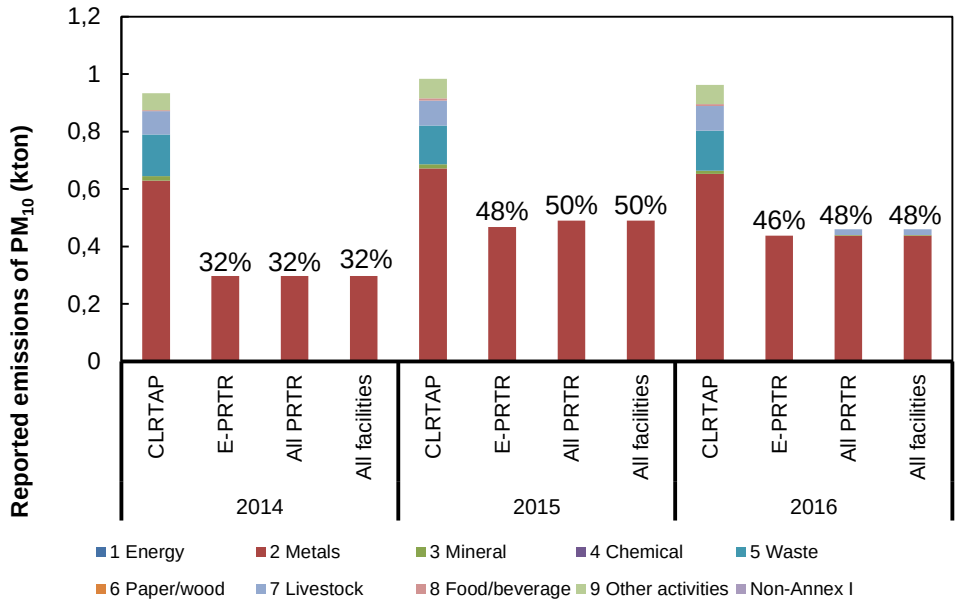

Figure 20. Comparison between Iceland's reported emissions of PM_{10} (kton) per sector according to CLRTAP, E-PRTR, National database-All PRTR and National database-All facilities for 2014–2016.

National environmental databases for Norway and Sweden

Facilities reporting emissions to the national environmental databases of Norway and Sweden may be divided into the following categories: "Annex I" or "Non-annex I" and "Above threshold" or "Below threshold" according to Annex II. This distribution of reported emission quantities for the year 2016 is presented in Table 2. In the table it can be seen that, if the pollutant thresholds were removed for Annex I facilities, both countries would capture emissions from Annex I facilities that constitute more than 90 % of the total emissions in the databases. This is valid for all pollutants except for SO_X in Norway and NH_3 in Sweden. In the table it can also be seen that the contribution from Non-annex I facilities above the thresholds for these pollutants is significant. However, underlying data for Sweden indicates that some of the livestock industries that contributes to the NH_3 emissions probably should be classified as Annex I facilities. For Norway it can be noted that one Non-Annex I energy facility contributes substantially to the emissions of SO_X. The classification of these facilities needs to be investigated further by the countries.

Furthermore, it should be noted that if the pollutant thresholds were removed it would result in a large increase in the number of facilities that are subject to reporting according to E-PRTR. Norway already includes Annex I facilities below the pollutant thresholds in their report to EU. For Sweden, on the other hand, the number of facilities included in the report would increase substantially. For Sweden the Annex I facilities below the pollutant thresholds contribute approximately 15-25 % of the total emissions for the selected pollutants reported to the national database. Notably is that Sweden applies lower thresholds for NO_X and NH_3 for all activities and has no thresholds for LCPs (NO_X, SO_X and TSP).

Table 2. Distribution of reported quantities and number of facilities (Annex I and Non-annex I) above and below thresholds per pollutant for Norway and Sweden.

Country	Pollu-tant	Annex I				Non-annex I			
		Above threshold (kton)	No.	Below threshold (kton)	No.	Above threshold (kton)	No.	Below threshold (kton)	No.
Norway	NO_X	94%	71	3.9%	135	0.5%	2	1.1%	73
	SO_X	72%	18	13%	149	14%	1	0.3%	45
	NH_3	97%	8	2.3%	7	0.0%	0	0.3%	4
	PM_{10}	80%	15	12%	85	6.1%	2	2.1%	41
Sweden	NO_X	73%	56	23%	256	0.4%	1	3.8%	106
	SO_X	74%	16	24%	209	1.6%	1	0.4%	37
	NH_3	71%	130	18%	202	9.8%	31	2.1%	27
	PM_{10}	83%	23	15%	194	0%	0	1.3%	53

Water

For releases to water, the thresholds according to Annex II and the respective countries are presented in Table 3 for the selected pollutants. Denmark and Iceland apply thresholds according to Annex II, whereas Sweden applies much lower thresholds for all of the selected pollutants, and Norway does not apply thresholds at all.

Table 3. Tot-N, Tot-P, Hg and Pb thresholds (kg) from Annex II (PRTR protocol and the E-PRTR regulation) and from national environmental data reporting systems for Sweden, Norway, Denmark and Iceland.

Pollutant	Annex II	Sweden	Norway	Denmark*	Iceland
Total nitrogen (Tot-N)	50 000	6 000	0	50 000	50 000
Total phophorus (Tot-P)	5 000	100	0	5 000	5 000
Mercury and compounds (as Hg)	1	0.1	0	1	1
Lead and compounds (as Pb)	20	5	0	20	20

* - before 2015 Denmark´s national thresholds for Tot-N, Tot-P, Hg and Pb were lower than EPRTR/PRTR.

Comparison at country-level per pollutant

Data reported to the E-PRTR and the national environmental reporting databases have been compiled for Total nitrogen (Tot-N), Total phosphorus (Tot-P), mercury (Hg) and lead (Pb) for all countries included in the study. Data reported to the national environmental databases are presented in the figures below in two different categories; “All PRTR” (including Annex I facilities within the database) and “All facilities” (including all facilities available in the database).

Since both Denmark (from 2015 onwards) and Iceland only collect data for facilities with activities according to Annex I and pollutant thresholds according to Annex II, it has not been considered an added value to include data for these countries in the analysis.

Total nitrogen (Tot-N)

For Norway, the emissions of Total nitrogen reported to the E-PRTR are approximately 60 % of the emissions reported to the national database (see Figure 21). The aquaculture industry is the dominating source of Total nitrogen in Norway according to E-PRTR. It can be seen that Non-annex I facilities (No PRTR) contribute approximately 30 % of the total emissions in the database. The dominating sources among Non-annex I facilities are aquaculture (60%) and waste-water treatment plants (40%).

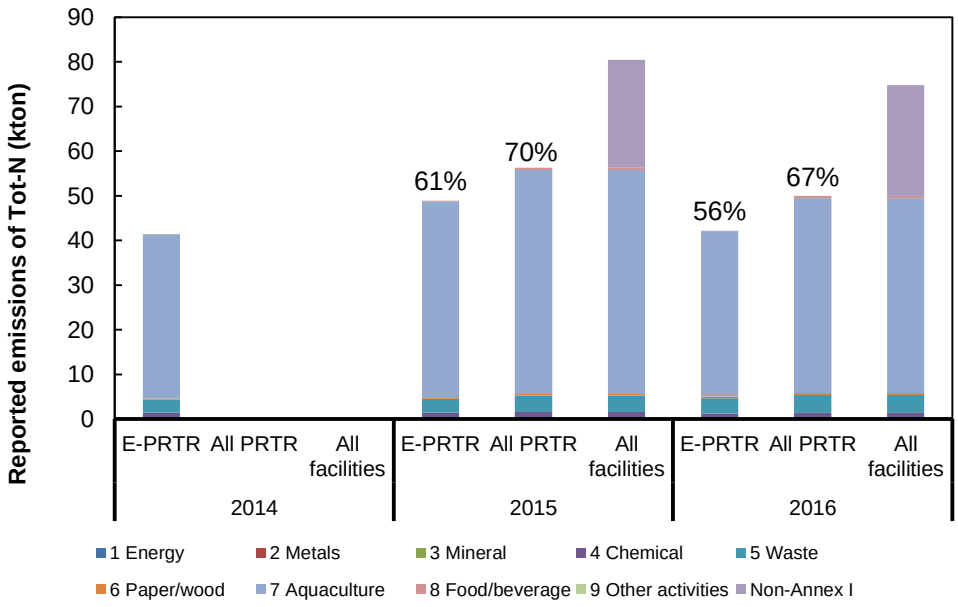

Figure 21. Comparison between Norway's reported emissions of Total Nitrogen (kton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

For Sweden, the emissions of Total nitrogen reported to the E-PRTR are approximately 45 % of the emissions reported to the national database (see Figure 22). Waste-water treatment plants are the dominating source of Total nitrogen in Sweden according to E-PRTR. Non-annex I facilities contribute approximately 50 % of the total emissions in the database. The dominating industry among Non-annex I facilities is waste-water treatment plants (98%). It has been noticed in underlying data for Sweden that some of the aquaculture facilities contributing to the total nitrogen emissions probably should be classified as Annex I facilities. The classification of these facilities needs to be investigated further by the country.

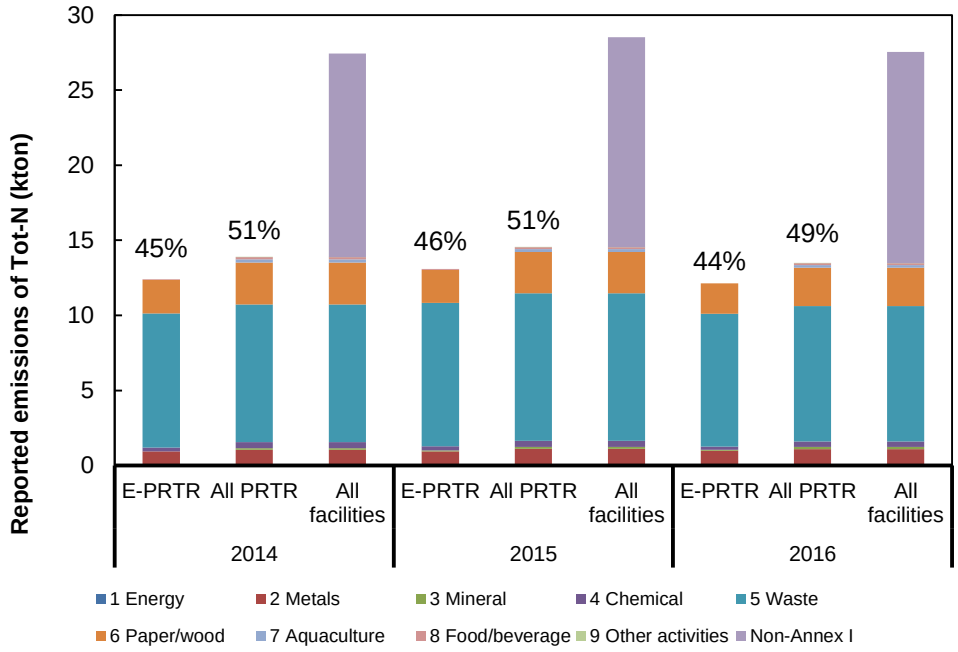

Figure 22. Comparison between Sweden's reported emissions of Total Nitrogen (kton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

Total Phosphorous (Tot-P)

For Norway, the emissions of Total Phosphorus reported to the E-PRTR are approximately 70 % of the emissions reported to the national database (see Figure 23). The aquaculture industry is the dominating source of Total phosphorus in Norway according to E-PRTR. Non-annex I facilities (No PRTR) contribute approximately 30 % of the total emissions in the database. The dominating industries among Non-annex I facilities are aquaculture (80%) and waste-water treatment plants (20%).

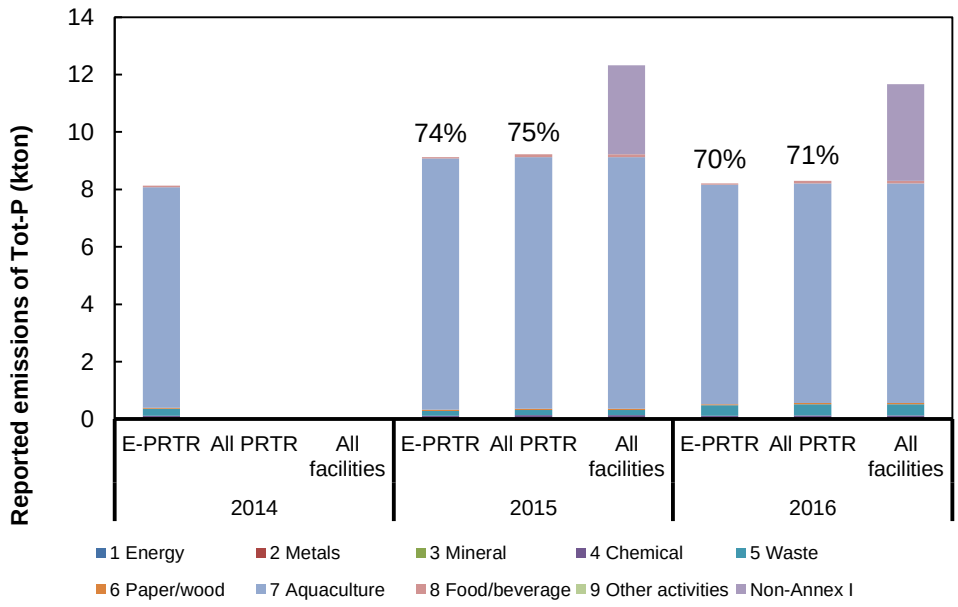

Figure 23. Comparison between Norway's reported emissions of Total Phosphorous (kton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

For Sweden, the emissions of Total phosphorus reported to E-PRTR are approximately 55 % of the emissions reported to the national database (see Figure 24). The pulp and paper industry is the dominating source of Total phosphorus in Sweden according to E-PRTR. Non-annex I facilities (No PRTR) contribute approximately 30 % of the total emissions in the database. The dominating industry among Non-annex I facilities is waste-water treatment plants (75%).

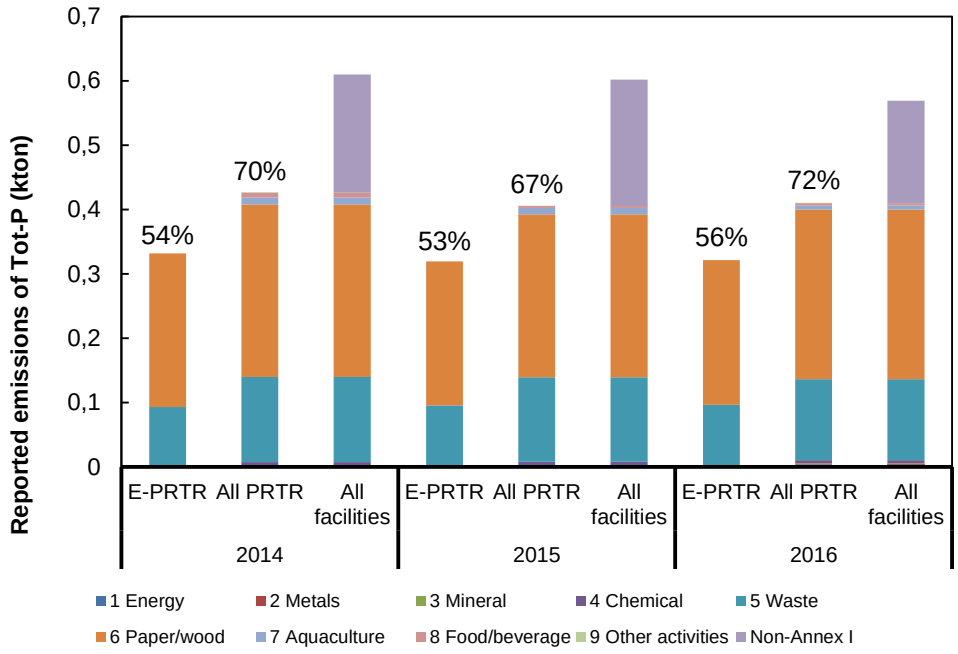

Figure 24. Comparison between Sweden's reported emissions of Total Phosphorous (kton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

Mercury (Hg)

For Norway, the emissions of mercury reported to the E-PRTR are approximately 45-50 % of the emissions reported to the national database (see Figure 25). Several industries contribute to the releases of mercury in Norway according to E-PRTR. Non-annex I facilities (No PRTR) contribute approximately 15 % of the total emissions in the database. The dominating industries among Non-annex I facilities are waste-water treatment plants (65%) and landfills (32%).

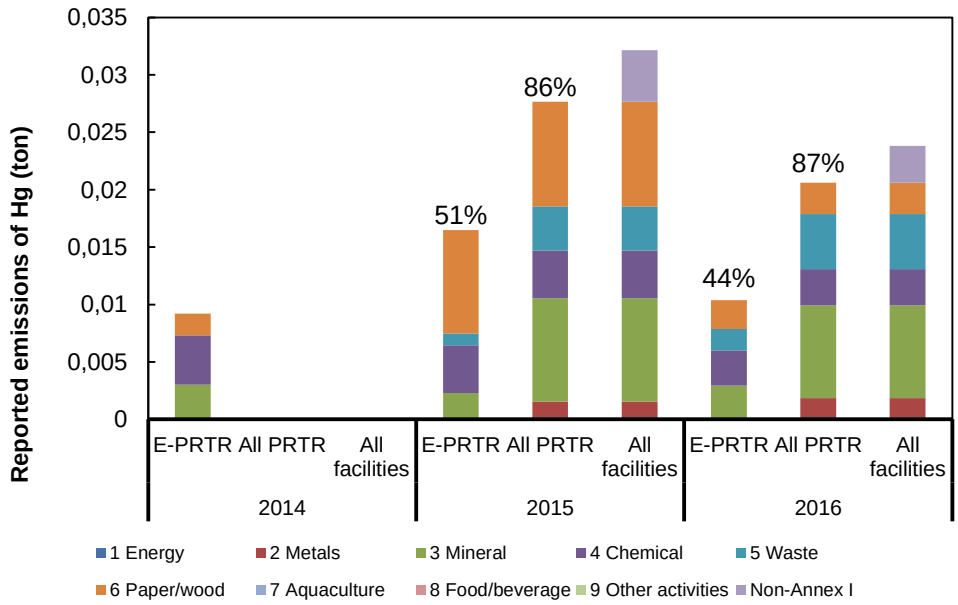

Figure 25. Comparison between Norway's reported emissions of mercury (ton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

For Sweden, the emissions of mercury reported to the E-PRTR are approximately 30-50 % of the emissions reported to the national database (see Figure 26). Several industries contribute to the releases of mercury in Sweden according to E-PRTR. Non-annex I facilities (No PRTR) contribute approximately 30-50 % of the total emissions in the database. The dominating industry among Non-annex I facilities is waste-water treatment plants (99%).

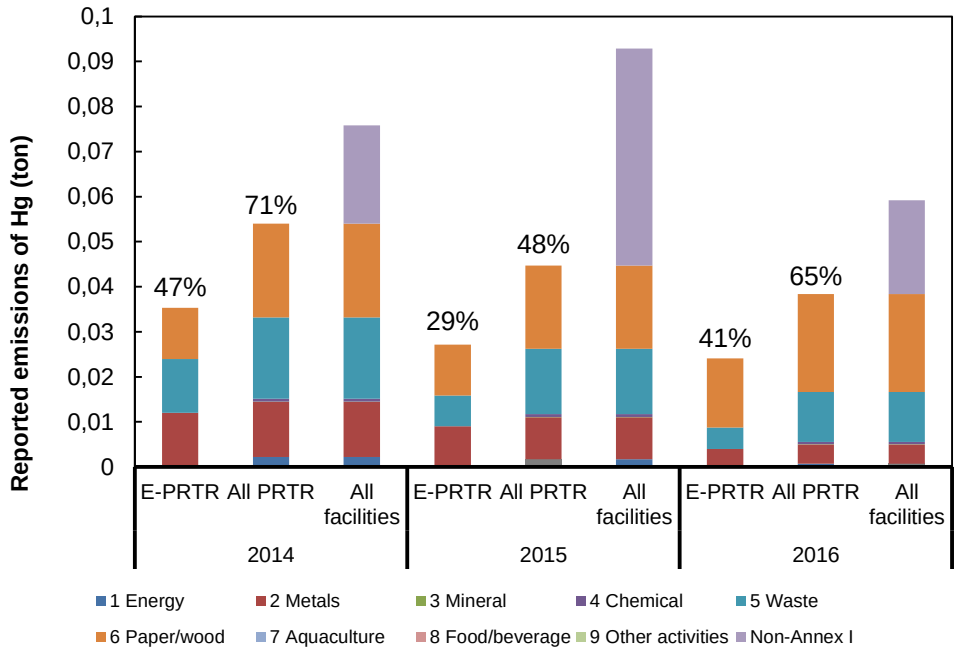

Figure 26. Comparison between Sweden's reported emissions of mercury (ton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

Lead (Pb)

For Norway, the emissions of lead reported to the E-PRTR are approximately 75 % of the emissions reported to the national database (see Figure 27). Several industries contribute to the releases of lead in Norway according to E-PRTR. Non-annex I facilities (No PRTR) contribute approximately 10 % of the total emissions in the database. The dominating industry among Non-annex I facilities is waste-water treatment plants (72%).

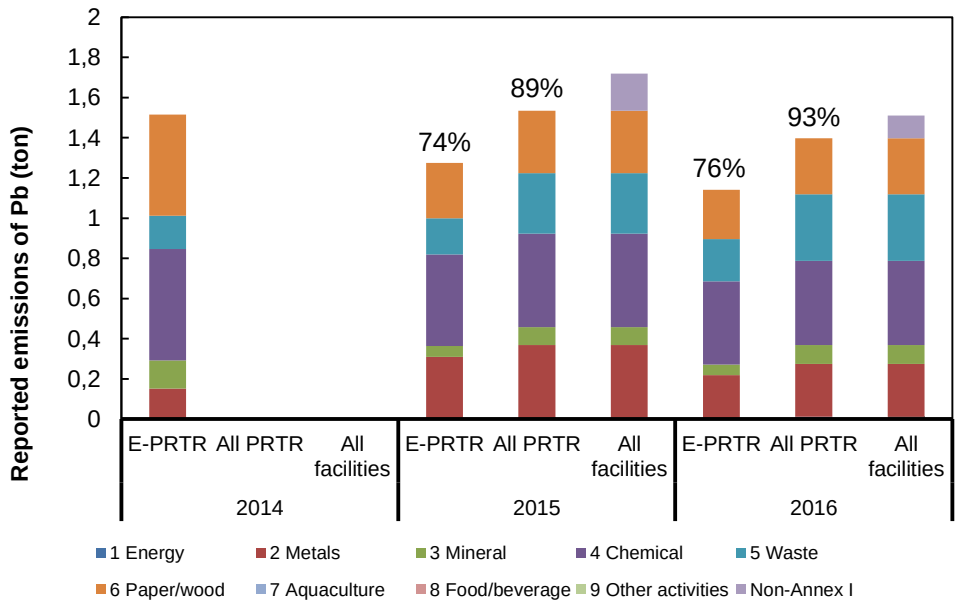

Figure 27. Comparison between Norway's reported emissions of lead (ton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

For Sweden, the emissions of lead reported to the E-PRTR are 65-69 % of the emissions reported to the national database (see Figure 28). The pulp and paper industry is the dominating source of lead in Sweden according to E-PRTR. Non-annex I facilities (No PRTR) contribute approximately 10 % of the total emissions in the database. The dominating industry among Non-annex I facilities is waste-water treatment plants (71%).

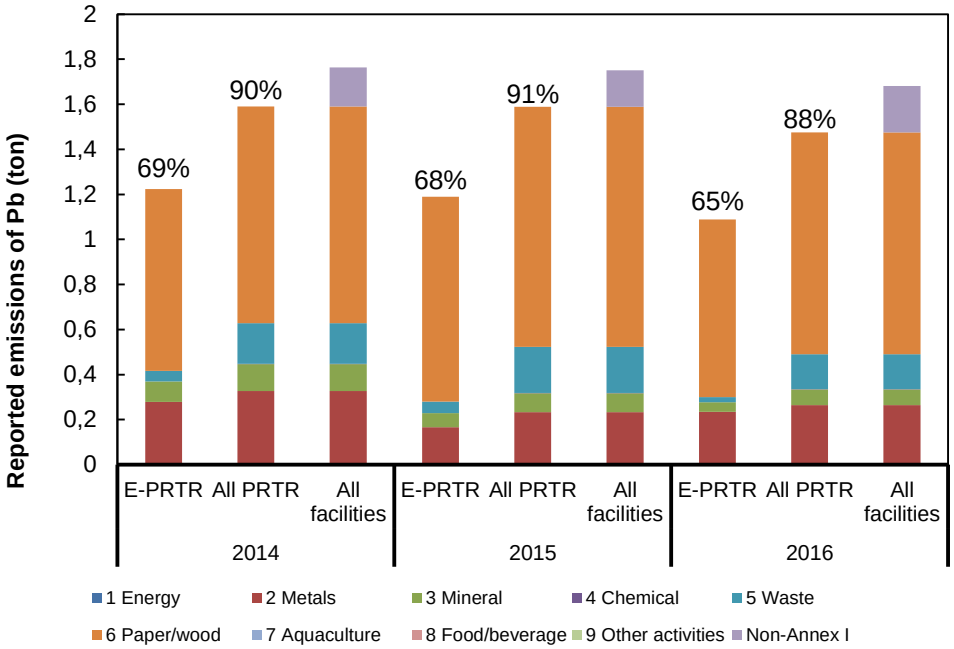

Figure 28. Comparison between Sweden's reported emissions of lead (kton) per sector according to E-PRTR and the National database-All PRTR and National database-All facilities for 2014–2016.

National environmental database for Norway and Sweden

Facilities reporting emissions to the national environmental databases of Norway and Sweden may be divided into the following categories: "Annex I" or "Non-annex I" and "Above threshold" or "Below threshold" according to Annex II. This distribution of reported emission quantities for the year 2016 is presented in Table 4. It can be seen that if the pollutant thresholds were removed the Annex I facilities would capture more that 90 % of the total emissions of lead available in the national database for both countries. For total nitrogen, total phosphorus and mercury it would not be enough to remove the pollutant thresholds to capture 90 % of total emissions. For these pollutants the capacity thresholds for the waste-water treatment plants and aquaculture need to be analysed further.

As for emissions to air it can be noted is that if the pollutant thresholds were removed it would result in a large increase in the number of facilities that are subject to reporting according to E-PRTR. Norway already includes

Annex I facilities below the pollutant thresholds in their report to the EU. For Sweden, on the other hand, the number of facilities included in the report to the EU would increase. However, it is important to keep in mind that operators of wastewater treatment plants below the capacity threshold according to Annex I is already required to report to the national environmental reporting database.

Table 4. Distribution of reported quantities and number of facilities (Annex I and Non-annex I) above and below thresholds per pollutant for Norway and Sweden.

	Pollutant	Annex I				Non-annex I			
		Above threshold (kton)	No.	Below threshold (kton)	No.	Above threshold (kton)	No.	Below threshold (kton)	No.
Norway	Total N	56%	388	10%	273	23%	151	10%	1239
	Total P	70%	568	0.8%	113	21%	196	7.5%	1589
	Hg	44%	6	43%	157	0%	0	13%	109
	Pb	80%	15	18%	170	1.9%	1	0.2%	109
Sweden	Total N	44%	49	4.8%	146	31%	65	20%	412
	Total P	56%	24	16%	156	5.1%	4	23%	490
	Hg	41%	12	24%	94	1.7%	1	33%	107
	Pb	71%	15	25%	118	2.9%	1	1.3%	107

Conclusions

Air

The reported emissions of NO_X and SO_X are lower in the E-PRTR dataset compared to CLRTAP on a European level. Based on the information from the national environmental databases for Norway, Sweden and Denmark (2014) the most important reason for this seems to be too high pollutant thresholds. Annex I facilities above and below the pollutant threshold represents over 90% of the reported emission in the Norwegian and Swedish environmental reporting databases.

The reported emissions of NH_3 according to E-PRTR are much lower compared to CLRTAP. Based on the information from the national environmental databases for all Nordic countries it would not be enough to remove the pollutant threshold to cover 90% of the CLRTAP emissions. The major source of releases is the livestock industry and lowering the capacity threshold for this activity would probably have a large effect on the coverage. Therefore, it would be relevant to further investigate both the pollutant threshold and the capacity threshold for the livestock industry. It could also be relevant to evaluate the EMEP/EEA guidebook methodologies used in CLRTAP for livestock.

The reported emissions of PM_{10} according to E-PRTR are much lower compared to those reported to CLRTAP for all industrial sectors. This could indicate that the threshold for the pollutant is too high in E-PRTR. However, based on the information from the national environmental databases for all Nordic countries it would not be enough to remove the pollutant threshold to cover 90% of the CLRTAP emissions. PM_{10} from livestock industry is included in the reporting to CLRTAP, while missing in the national environmental reporting databases and thus not reported to E-PRTR. According to the indicative sector specific sub-list of air pollutants given in the E-PRTR guidelines (Appendix 4) PM_{10} is not expected from livestock, while in EMEP/EEA guidebook it is included.[17] The E-PRTR guidelines needs to be updated to be in line with the EMEP/EEA guidebook. It could also be relevant to evaluate the emission factors for PM_{10} given in the EMEP/EEA guidebook.

[17] https://www.eea.europa.eu/publications/emep-eea-guidebook-2016/part-b-sectoral-guidance-chapters/4-agriculture/3-b-manure-management-2016/view

Water

For emissions to water, no dataset exists corresponding to CLRTAP, therefore any comparison on European level could not be made. Consequently, comparisons for water can only be made between two datasets, data reported to the national environmental reporting databases and to E-PRTR. It has only been possible to compare the E-PRTR data set with the available information in the national environmental reporting databases for Norway and Sweden.

If the pollutant threshold for Pb was removed, Annex I facilities would capture more than 90% of the total emissions reported in the Norwegian and Swedish environmental databases. However, for total nitrogen, total phosphorus and Hg, removing the pollutant thresholds would not be enough to capture 90 % of total emissions in the databases. Based on the analysis for these pollutants it would be valuable to evaluate the capacity thresholds for waste-water treatment plants and aquaculture.

Appendix 1

Mapping table between NFR-code and PRTR-sector.

NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	Included	PRTR-sector
A_PublicPower	1A1a	Public electricity and heat production	Yes	1 Energy
B_Industry	1A1b	Petroleum refining	Yes	1 Energy
B_Industry	1A1c	Manufacture of solid fuels and other energy industries	Yes	3 Mineral
B_Industry	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	Yes	2 Metal
B_Industry	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	Yes	2 Metal
B_Industry	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	Yes	4 Chemical
B_Industry	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	Yes	6 Paper/wood
B_Industry	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	Yes	8 Food/beverage
B_Industry	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	Yes	3 Mineral
I_Offroad	1A2gvii	Mobile Combustion in manufacturing industries and construction: (please specify in the IIR)	No	-
B_Industry	1A2gviii	Stationary combustion in manufacturing industries and construction: Other (please specify in the IIR)	No	-
H_Aviation	1A3ai(i)	International aviation LTO (civil)	No	-
H_Aviation	1A3aii(i)	Domestic aviation LTO (civil)	No	-
F_RoadTransport	1A3bi	Road transport: Passenger cars	No	-
F_RoadTransport	1A3bii	Road transport: Light duty vehicles	No	-
F_RoadTransport	1A3biii	Road transport: Heavy duty vehicles and buses	No	-
F_RoadTransport	1A3biv	Road transport: Mopeds & motorcycles	No	-
F_RoadTransport	1A3bv	Road transport: Gasoline	No	-

NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	Included	PRTR-sector
		evaporation		
F_RoadTransport	1A3bvi	Road transport: Automobile tyre and brake wear	No	-
F_RoadTransport	1A3bvii	Road transport: Automobile road abrasion	No	-
I_Offroad	1A3c	Railways	No	-
G_Shipping	1A3di(ii)	International inland waterways	No	-
G_Shipping	1A3dii	National navigation (shipping)	No	-
I_Offroad	1A3ei	Pipeline transport	No	-
I_Offroad	1A3eii	Other (please specify in the IIR)	No	-
C_OtherStationaryComb	1A4ai	Commercial/institutional: Stationary	No	-
I_Offroad	1A4aii	Commercial/institutional: Mobile	No	-
C_OtherStationaryComb	1A4bi	Residential: Stationary	No	-
I_Offroad	1A4bii	Residential: Household and gardening (mobile)	No	-
C_OtherStationaryComb	1A4ci	Agriculture/Forestry/Fishing: Stationary	No	-
I_Offroad	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	No	-
I_Offroad	1A4ciii	Agriculture/Forestry/Fishing: National fishing	No	-
C_OtherStationaryComb	1A5a	Other stationary (including military)	No	-
I_Offroad	1A5b	Other, Mobile (including military, land based and recreational boats)	No	-
D_Fugitive	1B1a	Fugitive emission from solid fuels: Coal mining and handling	Yes	1 Energy
D_Fugitive	1B1b	Fugitive emission from solid fuels: Solid fuel transformation	Yes	1 Energy
D_Fugitive	1B1c	Other fugitive emissions from solid fuels	No	-
D_Fugitive	1B2ai	Fugitive emissions oil: Exploration, production, transport	No	-
D_Fugitive	1B2aiv	Fugitive emissions oil: Refining / storage	Yes	1 Energy
D_Fugitive	1B2av	Distribution of oil products	No	-
D_Fugitive	1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	No	-
D_Fugitive	1B2c	Venting and flaring (oil, gas, combined oil and gas)	Yes	1 Energy

NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	Included	PRTR-sector
D_Fugitive	1B2d	Other fugitive emissions from energy production	No	-
B_Industry	2A1	Cement production	Yes	3 Mineral
B_Industry	2A2	Lime production	Yes	3 Mineral
B_Industry	2A3	Glass production	Yes	3 Mineral
B_Industry	2A5a	Quarrying and mining of minerals other than coal	Yes	3 Mineral
B_Industry	2A5b	Construction and demolition	No	-
B_Industry	2A5c	Storage, handling and transport of mineral products	No	-
B_Industry	2A6	Other mineral products (please specify in the IIR)	Yes	3 Mineral
B_Industry	2B1	Ammonia production	Yes	4 Chemical
B_Industry	2B2	Nitric acid production	Yes	4 Chemical
B_Industry	2B3	Adipic acid production	Yes	4 Chemical
B_Industry	2B5	Carbide production	Yes	4 Chemical
B_Industry	2B6	Titanium dioxide production	Yes	4 Chemical
B_Industry	2B7	Soda ash production	Yes	4 Chemical
B_Industry	2B10a	Chemical industry: Other (please specify in the IIR)	Yes	4 Chemical
B_Industry	2B10b	Storage, handling and transport of chemical products (please specify in the IIR)	No	-
B_Industry	2C1	Iron and steel production	Yes	2 Metal
B_Industry	2C2	Ferroalloys production	Yes	2 Metal
B_Industry	2C3	Aluminium production	Yes	2 Metal
B_Industry	2C4	Magnesium production	Yes	2 Metal
B_Industry	2C5	Lead production	Yes	2 Metal
B_Industry	2C6	Zinc production	Yes	2 Metal
B_Industry	2C7a	Copper production	Yes	2 Metal
B_Industry	2C7b	Nickel production	Yes	2 Metal
B_Industry	2C7c	Other metal production (please specify in the IIR)	Yes	2 Metal
B_Industry	2C7d	Storage, handling and transport of metal products (please specify in the IIR)	No	-
E_Solvents	2D3a	Domestic solvent use including fungicides	No	-
B_Industry	2D3b	Road paving with asphalt	No	-

NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	Included	PRTR-sector
B_Industry	2D3c	Asphalt roofing	No	-
E_Solvents	2D3d	Coating applications	No	-
E_Solvents	2D3e	Degreasing	No	-
E_Solvents	2D3f	Dry cleaning	No	-
E_Solvents	2D3g	Chemical products	Yes	4 Chemical
E_Solvents	2D3h	Printing	Yes	9 Other activities
E_Solvents	2D3i	Other solvent use (please specify in the IIR)	Yes	9 Other activities
E_Solvents	2G	Other product use (please specify in the IIR)	Yes	9 Other activities
B_Industry	2H1	Pulp and paper industry	Yes	6 Paper/wood
B_Industry	2H2	Food and beverages industry	Yes	8 Food/beverage
B_Industry	2H3	Other industrial processes (please specify in the IIR)	Yes	9 Other activities
B_Industry	2I	Wood processing	Yes	6 Paper/wood
B_Industry	2J	Production of POPs	Yes	4 Chemical
B_Industry	2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	No	-
B_Industry	2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	No	-
K_AgriLivestock	3B1a	Manure management - Dairy cattle	No	-
K_AgriLivestock	3B1b	Manure management - Non-dairy cattle	No	-
K_AgriLivestock	3B2	Manure management - Sheep	No	-
K_AgriLivestock	3B3	Manure management - Swine	Yes	7 Livestock/aquaculture
K_AgriLivestock	3B4a	Manure management - Buffalo	No	-
K_AgriLivestock	3B4d	Manure management - Goats	No	-
K_AgriLivestock	3B4e	Manure management - Horses	No	-
K_AgriLivestock	3B4f	Manure management - Mules and asses	No	-
K_AgriLivestock	3B4gi	Manure mangement - Laying hens	Yes	7 Livestock/aquaculture
K_AgriLivestock	3B4gii	Manure mangement - Broilers	Yes	7 Livestock/aquaculture

NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	Included	PRTR-sector
K_AgriLivestock	3B4giii	Manure mangement - Turkeys	Yes	7 Livestock/aquaculture
K_AgriLivestock	3B4giv	Manure management - Other poultry	Yes	7 Livestock/aquaculture
K_AgriLivestock	3B4h	Manure management - Other animals (please specify in IIR)	No	-
L_AgriOther	3Da1	Inorganic N-fertilizers (includes also urea application)	No	-
L_AgriOther	3Da2a	Animal manure applied to soils	No	-
L_AgriOther	3Da2b	Sewage sludge applied to soils	No	-
L_AgriOther	3Da2c	Other organic fertilisers applied to soils (including compost)	No	-
L_AgriOther	3Da3	Urine and dung deposited by grazing animals	No	-
L_AgriOther	3Da4	Crop residues applied to soils	No	-
L_AgriOther	3Db	Indirect emissions from managed soils	No	-
L_AgriOther	3Dc	Farm-level agricultural operations including storage, handling and transport of agricultural products	No	-
L_AgriOther	3Dd	Off-farm storage, handling and transport of bulk agricultural products	No	-
L_AgriOther	3De	Cultivated crops	No	-
L_AgriOther	3Df	Use of pesticides	No	-
L_AgriOther	3F	Field burning of agricultural residues	No	-
L_AgriOther	3I	Agriculture other (please specify in the IIR)	No	-
J_Waste	5A	Biological treatment of waste - Solid waste disposal on land	No	-
J_Waste	5B1	Biological treatment of waste - Composting	Yes	5 Waste
J_Waste	5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	Yes	5 Waste
J_Waste	5C1a	Municipal waste incineration	Yes	5 Waste
J_Waste	5C1bi	Industrial waste incineration	Yes	5 Waste
J_Waste	5C1bii	Hazardous waste incineration	Yes	5 Waste
J_Waste	5C1biii	Clinical waste incineration	Yes	5 Waste
J_Waste	5C1biv	Sewage sludge incineration	Yes	5 Waste

NFR Aggregation for Gridding and LPS (GNFR)	NFR Code	Longname	Included	PRTR-sector
J_Waste	5C1bv	Cremation	No	-
J_Waste	5C1bvi	Other waste incineration (please specify in the IIR)	No	-
J_Waste	5C2	Open burning of waste	No	-
J_Waste	5D1	Domestic wastewater handling	Yes	5 Waste
J_Waste	5D2	Industrial wastewater handling	Yes	5 Waste
J_Waste	5D3	Other wastewater handling	No	-
J_Waste	5E	Other waste (please specify in IIR)	No	-
M_Other	6A	Other (included in national total for entire territory) (please specify in IIR)	No	-
O_AviCruise	1A3ai(ii)	International aviation cruise (civil)	No	-
O_AviCruise	1A3aii(ii)	Domestic aviation cruise (civil)	No	-
P_IntShipping	1A3di(i)	International maritime navigation	No	-
z_Memo	1A5c	Multilateral operations	No	-
z_Memo	1A3	Transport (fuel used)	No	-
z_Memo	6B	Other not included in national total of the entire territory (please specify in the IIR)	No	-
N_Natural	11A	Volcanoes	No	-
N_Natural	11B	Forest fires	No	-
N_Natural	11C	Other natural emissions (please specify in the IIR)	No	-

Appendix 2

Pollutant thresholds for Sweden, E-PRTR regulation and PRTR Protocol.

Pollutant	Threshold (kg)					
	Sweden		E-PRTR regulation		PRTR protocol	
	to air	to water	to air	to water	to air	to water
Methane (CH4)	100000		100000		100000	
Carbon monoxide (CO)	500000		500000		500000	
Carbon dioxide (CO2)	100000000		100000000		100000000	
Hydro-fluorcarbons (HFCs)	100		100		100	
Nirous oxide (N2O)	10000		10000		10000	
Ammonia (NH3)	1000		10000		10000	
Non-methane volatile organic carbons (NMVOC)	5000		100000		100000	
Nitrogen oxides (NOX/NO2)	10000		100000		100000	
Perfluorcarbons (PFCs)	10		10		10	
Sulphur hexafluoride (SF6)	50		50		50	
Sulphur oxides (SOX/SO2)	150000		150000		150000	
Total nitrogen		6000		50000		50000
Total phosphorus		100		5000		5000
Hydrochlorocarbons (HCFCs)	1		1		1	
Chlorofluorocarbons (CFCs)	1		1		1	
Halons	1		1		1	
Arsenic and compounds (as As)	1	1	20	5	20	5
Cadmium and compounds (as Cd)	0.1	1	10	5	10	5
Chromium and compounds (as Cr)	10	20	100	50	100	50
Copper and compounds (as Cu)	10	20	100	50	100	50
Mercury and	0.1	0.1	10	1	10	1

Pollutant	Threshold (kg)					
	Sweden		E-PRTR regulation		PRTR protocol	
	to air	to water	to air	to water	to air	to water
compounds (as Hg)						
Nickel and compounds (as Ni)	10	20	50	20	50	20
Lead and compounds (as Pb)	5	5	200	20	200	20
Zinc and compounds (as Zn)	100	20	200	100	200	100
Alachlor		1		1		1
Aldrin	1	1	1	1	1	1
Atrazine		1		1		1
Chlordane	1	1	1	1	1	1
Chlordecone	1	1	1	1	1	1
Chlorfenvinphos		1		1		1
Chloro-alkanes (C10-C13)	1	1	0	1	0	1
Chlorpyrifos		1		1		1
DDT	1	1	1	1	1	1
1,2-dichloroethane (EDC)	1	1	1000	10	1000	10
Dichloromethane (DCM)	1000	10	1000	10	1000	10
Dieldrin	1	1	1	1	1	1
Diuron		1		1		1
Endosulphan		1		1		1
Endrin	1	1	1	1	1	1
Halogenated organic compounds (as AOX)		1000		1000		1000
Heptachlor	1	1	1	1	1	1
Hexachlorobenzene (HCB)	10	1	10	1	10	1
Hexachlorobutadiene (HCBD)	1	1	0	1	0	1
1,2,3,4,5,6-hexachlorocyclohexane (HCH)	10	1	10	1	10	1
Lindan	1	1	1	1	1	1
Mirex	1	1	1	1	1	1

Pollutant	Threshold (kg)					
	Sweden		E-PRTR regulation		PRTR protocol	
	to air	to water	to air	to water	to air	to water
PCDD+PCDF (dioxins + furans) (as Teq)	0.000001	0.0001	0.0001	0.0001	0.001	0.001
Pentaklorbenzene	1	1	1	1	1	1
Pentachlorophenol (PCP)	10	10	10	10	10	10
Polychlorinated biphenyls (PCBs)	0.1	0.1	0.1	0.1	0.1	0.1
Simazine		1		1		1
Tetrachloroethylene (PER)	1	1	2000	10	2000	0
Tetrachloromethane (TCM)	100	1	100	1	100	0
Trichlorobenzenes (TCBs) (all isomeres)	1	1	10	1	10	0
1,1,1-trichloroethane	100		100		100	
1,1,2,2-tetrachloroethane	50		50		50	
Trichloroethylene	1	1	2000	10	2000	0
Trichloromethane	1	1	500	10	500	0
Toxaphene	1	1	1	1	1	1
Vinyl chloride	1000	10	1000	10	1000	10
Anthracene	50	1	50	1	50	1
Benzene	100		1000		1000	
Benzene (as BTEX)		100		200		200
Brominated diphenylethers (PBDE)	1	1	0	1	0	1
Nonylphenol and Nonylphenol ethoxylates (NP/NPEs)		1		1		1
Ethyl benzene	100		0		0	
Ethyl benzene (as BTEX)		100		200		200
Ethylene oxide	1000	10	1000	10	1000	10
Isoproturon		1		1		1
Naphtalene	100	10	100	10	100	10
Organotin compounds (as total		50		50		50

Pollutant	Threshold (kg)					
	Sweden		E-PRTR regulation		PRTR protocol	
	to air	to water	to air	to water	to air	to water
Sn)						
Di-(2-ethyl hexyl)phthalate (DEPH)	1	1	10	1	10	1
Phenols (as total C)	1	20	0	20	0	20
Polycyclic aromatic hydrocarbons (PAHs)	50	5	50	5	50	5
Toluene	100		0		0	
Toluene (as BTEX)		200		200		200
Tributyltin and compounds		1		1		1
Triphenyltin and compounds	1	0.1	0	1	0	1
Total organic carbon (TOC) (as total C or COD/3)		50000		50000		50000
Trifluralin		1		1		1
Xylenes	100		0		0	
Xylenes (as BTEX)		100		200		200
Chlorides (as total Cl)		2000000		2000000		2000000
Chlorine and inorganic compounds (as HCl)	10000		10000		10000	
Asbestos	1	1	1	1	1	1
Cyanides (as total CN)		50		50		50
Fluorides (as total F)		2000		2000		2000
Fluorine and inorganic compounds (as HF)	5000		5000		5000	
Hydrogen cyanides (HCN)	200		200		200	
Particulate matter (PM10)	50000		50000		50000	
Octylphenols and Octylphenol ethoxylates	1	1	0	1	0	0
Fluoranthene		1		1		0
Isodrin		1		1		0

Pollutant	Threshold (kg)					
	Sweden		E-PRTR regulation		PRTR protocol	
	to air	to water	to air	to water	to air	to water
Hexabromo-biphenyl	0.1	0.1	0.1	0.1	0	0
Benzo(g,h,i)-perylene		1		1		0