

AUSTRIA'S INFORMATIVE INVENTORY REPORT (IIR) 2024

***Submission under the UNECE Convention on
Long-range Transboundary Air Pollution and
Directive (EU) 2016/2284 on the reduction of
national emissions of certain
atmospheric pollutants***

REPORT
REP-0908

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Since 23 December 2005 the Umweltbundesamt has been accredited as Inspection Body for emission inventories, Type A (ID No. 0241), in accordance with EN ISO/IEC 17020 and the Austrian Accreditation Law (AkkG), by decree of Accreditation Austria (first decree, No. BMWA-92.715/0036-I/12/2005, issued by Accreditation Austria / Federal Ministry of Economics and Labour on 19 January 2006).

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EXECUTIVE SUMMARY

ES.1 REPORTING OBLIGATIONS UNDER UNECE/LRTAP AND DIRECTIVE (EU) 2016/2284 (NEC DIRECTIVE)

Austria's Informative Inventory Report (IIR) and the complete set of NFR tables (the latter are submitted in digital format only) represent Austria's official submission under the United Nations Economic Commission for Europe (UNECE) Convention on Long-range Transboundary Air Pollution (LRTAP) and under Directive (EU) 2016/2284 (NEC Directive). The Umweltbundesamt in its role as single national entity regarding emission inventories compiles Austria's annual delivery, and the Austrian Federal Ministry of 'Climate Action, Environment, Energy, Mobility, Innovation and Technology' (BMK) submits it officially to the Executive Secretary of UNECE as well as to the European Commission.

As a party to the UNECE/LRTAP Convention and according to the reporting obligations of the NEC Directive Austria is required to annually report data on emissions of air pollutants covered in the Convention and its Protocols:

- main pollutants: nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC), sulphur oxides (SO_x), ammonia (NH_3) and carbon monoxide (CO);
- particulate matter (PM): primary PM (fine particulate matter ($\text{PM}_{2.5}$) and coarse particulate matter (PM_{10})¹;
- priority heavy metals (HMs): lead (Pb), cadmium (Cd) and mercury (Hg);
- persistent organic pollutants (POPs): polychlorinated dibenzodioxins/dibenzofurans (PCDD/Fs), polycyclic aromatic hydrocarbons (PAHs), hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs).

In order to fulfil these reporting requirements, Austria compiles an Air Emission Inventory ("Österreichische Luftschadstoff-Inventur – OLI"), which is updated annually. The IIR contains information on Austria's inventories of air pollutants for all years from 1990 to 2022 for the main pollutants, for POPs and HMs and for the years 1990, 1995 and from 2000 onwards for PM. In accordance with the NEC Directive (EU) 2016/2284, Table A (*Annual emission reporting requirements*) and Table C (*Reporting requirements on emissions and projections*), Austria does not report emissions of BC (notation key NR is used).

From submission 2020 onwards, Austria reports all pollutants in the NFR19 reporting format from 1990 to the latest inventory year. Emissions of the years before 1990 were last updated and published in submission 2014.²

In addition, the report includes both detailed descriptions of methods, data sources and uncertainties and information on quality assurance and quality control (QA/QC) activities as well as analyses of emission trends.

¹ According to the CLRTAP Reporting GL the reporting of total suspended particulates (TSPs) is not mandatory, but reported by Austria.

² Austria's submission 2014 under the Convention on Long-range Transboundary Air Pollution covering the years 1980–2012: https://cdr.eionet.europa.eu/at/un/CLRTAP_AT/envuvyara/

The emission data presented in this report were compiled according to the 2023 Reporting Guidelines that were adopted by the Executive Body for the UNECE/LRTAP Convention at its 42nd session.

The Austrian inventory is complete with regard to reported gases, reported years and reported emissions from all sources, and also complete in terms of geographic coverage.

ES.2 DIFFERENCES WITH OTHER REPORTING OBLIGATIONS

NEC Directive (EU) 2016/2284 sets out national emission reduction commitments for the pollutants SO₂, NO_x, VOC, NH₃ and PM_{2.5}. Emission reduction obligations will apply to anthropogenic emissions of these pollutants and also particulate matter (PM_{2.5}) covering the years from 2020 to 2029 and from 2030 onwards. While the target comparison for the years 2010 to 2019 was based on emissions without exports of fuels, Austria's total emissions calculated on the basis of the volume of fuel sold will now be taken into account for the current target period, as the emission reduction commitments from 2020 onwards have been derived from projections based on the amount of fuel sold.

The annual greenhouse gas reporting under the UNFCCC also requires the reporting of indirect GHGs (NO_x, CO, NMVOC) and SO₂ emissions based on *fuel sold*. In contrast to UNFCCC requirements, emissions from aviation under the NEC Directive and the LRTAP Convention include domestic LTO and cruise. Furthermore, international navigation of inland waterways is covered under NEC and CLRTAP.

ES.3 OVERVIEW OF EMISSION TRENDS

Main Pollutants

In 1990, national total SO₂ emissions amounted to 74 kt. Since then emissions have decreased quite steadily. In the year 2022, emissions were reduced by 85% compared to 1990 and amounted to 11 kt. This decline is mainly caused by a reduction of the sulphur content in mineral oil products and fuels (according to the Austrian Fuel Ordinance), the installation of desulphurisation units in plants (according to the Clean Air Act for boilers) and an increased use of low-sulphur fuels like natural gas. From 2021 to 2022, SO₂ emissions decreased by 0.9% (-0.1 kt) mainly because of other sectors (1.A.4, predominantly households). In the case of households (1.A.4.b.1), the reduction in the use of biomass (-20 %) and coal (-25 %) led to a significant decrease in emissions compared to the previous year. This is due to milder weather conditions and price changes on the energy market. This decline was partly offset by higher emissions from energy supply and increased production from industry, with only the paper industry showing a decline. SO₂ emissions from the paper industry (1.A.2.d) decreased by 20 % compared to 2021 due to lower production.

In 1990, national total NO_x emissions amounted to 216 kt. After an all-time high of emissions between 2003 and 2005 emissions are decreasing continuously mainly due to reductions in sector 1.A.3.b. In 2022, NO_x emissions amounted to 114 kt and were about 47% lower than in 1990. From

2021 to 2022 emissions decreased by 7.1%. One of the main reasons for this was the renewal of the fleet with low-emission vehicles in passenger car and truck traffic (1.A.3.b), which reduced the level of emissions despite an increase in mileage. NO_x emissions from fuel combustion of other sectors (1.A.4, predominantly households) fell significantly by 3.0 kt (and 15 %) compared to the previous year. This was due to the lower use of biomass, gas and oil, the milder weather and price changes on the energy market.

In 1990, national total NMVOC emissions amounted to 329 kt. Emissions have decreased steadily since then and in the year 2022 emissions were reduced by 70% to 100 kt compared to 1990. From 2021 to 2022, NMVOC emissions decreased by 8.0 kt (-7.4%). The largest reductions since 1990 have been achieved in the road transport sector due to an increased use of catalytic converters and diesel cars. Currently the road transport sector (1.A.3.b.) accounts only for a small share (3.5%) of Austria's total NMVOC emissions. Compared to the previous year, the emission reduction was mainly due to the decline in the use of biomass (-20 %) from residential heating as a result of the milder weather and price changes on the energy market and lower emissions from industrial paint application. Reductions in the solvent sector (2.D.3) have been achieved due to the Solvent Ordinance and the VOC Installation Ordinance.

In 1990, national total NH₃ emissions amounted to 74 kt; emissions have decreased over the period from 1990 to 2022. In 2022, emissions were 8.2% under 1990 levels and amounted to 68 kt. NH₃ in Austria is almost exclusively emitted in the agricultural sector. The lower NH₃ emissions can be explained by decreasing cattle numbers, more efficient feeding and an increased application of low emission spreading techniques (e.g. band spreading, trailing shoe, rapid incorporation of manure). Compared to the previous year 2021, total emissions decreased by 1.2 kt (-1.7%). The main reason for this reduction were falling emissions from mineral fertilizer application as a result of lower sales volumes due to the significant increase in energy and raw material prices, which led to higher prices on the fertilizer market. Furthermore, ammonia emissions decreased due to reductions in manure spreading because of the increased use of band spreading techniques in Austria.

In 1990, national total CO emissions amounted to 1 248 kt. Emissions decreased considerably from 1990 to 2022. In 2022, emissions were 61% below 1990 levels and amounted to 481 kt. This reduction was mainly due to decreasing emissions from road transport (catalytic converters). The emissions decreased between 2021 and 2022 by 11%, mainly in the category 1.A.4.b.i Residential: stationary as a consequence of the mild weather as well as changes in energy prices and the associated reduced use of biomass.

Particulate Matter

Particulate matter emissions in Austria mainly arise from 1.A Fuel Combustion Activities (1.A.3 Road transport, 1.A.4 Other sectors – residential heating), 2 Industrial Processes and Product Use and 3 Agriculture.

Particulate matter (PM) emissions show a decreasing trend over the period 1990 to 2022: TSP emissions decreased by 28%, PM₁₀ emissions were about 37% below the level of 1990, and PM_{2.5} emissions dropped by about 51%. In the transport sector PM emissions show a general decrease since several years as a result of improved technology. In the NFR sectors 1.A.4 Other and 2 Industrial Processes, PM emissions also fell since 1990. Between 2021 and 2022 TSP, PM₁₀ and PM_{2.5} emissions decreased by 6.6% (TSP), 6.8% (PM₁₀) and 9.6% (PM_{2.5}). The short-term decrease was largely influenced by sector residential heating (1.A.4.b.i) as a consequence of the mild weather as well as changes in

energy prices and the associated reduced use of biomass. In sector *2.A.5 Mining, construction/demolition and handling of products* the PM emission levels have also decreased in 2022 due to less construction activities.

Heavy Metals

Emissions of all three priority heavy metals (Cd, Pb and Hg) have decreased since 1990.

The overall Cd emissions reduction of 49% from 1990 to 2022 is mainly due to a decline in the industrial processes and energy sector, which is due to reduced use of heavy fuel oil and lower process emissions from iron and steel production. The decrease in 2022 compared to the previous year was mainly due to lower emissions from residential heating (*1.A.4.b.i Residential: stationary*).

The overall reduction of Hg of about 61% for the period 1990 to 2022 was due to decreasing emissions from cement industries and the industrial processes sector as well as due to reduced use of coal for residential heating and public electricity and heat production. Several bans in different industrial sub-sectors led to the sharp fall of total Hg emission in Austria, where the largest reduction was achieved in the early 90ies. Due to abatement measures emissions dropped from 2006 onwards. Between 2021 and 2022 emissions decreased by 5.3 % because of falling emissions from NFR *1.A.4.b Residential*. As a result of the warmer weather and price changes the biomass consumption dropped significantly compared to the previous year.

The overall reduction trend of Pb emissions was minus 94% for the period 1990 to 2022, which is mainly a result of the ban of lead in gasoline. However, abatement techniques and product substitutions also contributed to the emission reduction. Compared to the previous year total Pb emissions show a decrease of 0.7% mainly because of the lower consumption of biomass in *1.A.4.b.i Residential: stationary*.

Persistent Organic Pollutants (POPs)

Emissions of all POPs decreased remarkably from 1990 to 2022 (HCB -87%, PAH -69%, PCDD/F -74% and PCBs -92%), where the highest achievement was made until 1994. The significant increase of HCB emissions in the years 2012, 2013 and 2014 was due to unintentional releases of HCB by an Austrian cement plant.

In 2022 PCDD/F emissions decreased by 15 % compared to the previous year, HCB emissions decreased by 18% and PAH emissions by 21% in the same time. The reductions of HCB and PCDD/F emissions were mainly due to lower emissions from sectors *1.A.4.b Residential* and to a lesser extent from *2.C Metal Production (2.C.1 Iron and Steel Production and 2.C.3 Aluminium Production)*. PAH emissions fell because of lower emissions from *1.A.4.b Residential*. Decreasing HCB and PCDD/F emissions from *Iron and steel production* were due to changes in the production process and from *aluminium production* emissions followed production figures. In the residential sector emissions fell due to the lower heating demand because of the warmer weather but also due to the higher prices on the energy market.

In 2022 PCB emissions decreased by 9.8% compared to the previous year 2021 due to lower emissions from *2.C.1 Iron and Steel Production* as a result of changes in the production process and reduced hard coal consumption in *1.A.2.d Pulp, Paper and Print*.

The most important source of PAH, PCDD/F and HCB emissions in Austria is residential heating. In the 1980s industry and waste incineration were still important sources regarding POP emissions.

Due to legal regulations concerning air quality emissions from industry and waste incineration decreased remarkably from 1990 to 1993. For PCB emissions the most important source category is **2.C Metal Production**.

ES.4 KEY CATEGORIES

To determine key categories, a trend and a level assessment have been carried out, which resulted in 44 identified key categories. It shows that the residential sector has been identified as the most important key category: all air pollutants except for NH₃ are found key in either the trend or the level assessment. In the following table the top 5 ranked key categories are listed.

Table 1: Most relevant key categories in Austria for air emissions 2021.

Name of key category	No of occurrences as key category
1.A.4.b.1 – Residential: stationary	26 times (SO ₂ , NO _x , NMVOC, CO, Cd, Pb, Hg, PAH, DIOX, HCB, PCB, TSP, PM ₁₀ , PM _{2.5})
2.C.1 – Iron and Steel Production	13 times (Cd, Pb, Hg, PAH, DIOX, PCB, TSP, PM ₁₀ , PM _{2.5})
1.A.1.a – Public Electricity and Heat Production	12 times (SO ₂ , NO _x , Cd, Pb, Hg, DIOX, HCB, PM ₁₀ , PM _{2.5})
1.A.3.b.1 – R.T., Passenger cars	10 times (NO _x , NMVOC, CO, Pb, TSP, PM ₁₀ , PM _{2.5})
1.A.2.d – Pulp, Paper and Print	8 times (SO ₂ , NO _x , Cd, Hg, TSP, PM ₁₀ , PM _{2.5})

ES.5 MAIN DIFFERENCES IN THE INVENTORY SINCE THE LAST SUBMISSION

As a result of the continuous improvement process of Austria's Annual Air Emission Inventory, emissions for some sources have been recalculated, e.g. on the basis of updated activity data or revised methodologies. Thus emission data for the whole time series submitted this year differ from the data reported previously.

In NFR sector **1 Energy**, changes are mainly due to revisions of the energy balance. Energy consumption for non-road mobile machinery in the industrial sector has been revised for 2021 due to an update of the industrial production index. Minor revisions of PM emissions from subcategories **1.A.1.a** and **1.A.2.f** were due to error corrections.

For 1990 to 2021, minor changes in of categories Commercial/Institutional (**1.A.4.a**) and Residential (**1.A.4.b**) occurred because of updated heating stock data and newly allocated shares of combustion technologies per energy carrier (updated energy demand model for space heating).

Activity data (gasoline) in **1.B.2.a.5 Distribution of oil products** had to be corrected by one data supplier for the year 2021, resulting in slightly revised NMVOC emissions for 2021. PM emissions of **1.B.1.a Storage of solid fuels** for 2021 were revised due to revised coal consumption activity data.

In NFR sector **1.A.3 Transport**, the fuel consumption for PC and LDV PHEV has been revised. As the energy consumption in hybrid vehicles is highly uncertain, a more pessimistic charging behavior for PHEV vehicles has been assumed, which increased the real fuel consumption of PHEV cars (petrol) and LDV (petrol), especially in 2021. Furthermore, an update of specific vehicle mileage per year was undertaken, leading to an increase for LDV and 2-wheelers for 2021. Confidential data (fuel consumption) became available from a survey for military off-road vehicles for the year 2021. This evaluation and a separate expert assessment improved the trend from 1990 to 2022 for **1.A.5 Military**.

In NFR sector **2 Industrial Processes and Product Use** several recalculations have been carried out on the one hand due to revisions of activity data and on the other hand as a result of methodological improvements (e.g. reallocation in **2.B.1**; elimination of a time series inconsistency in **2.B.10**; reassessment of POPs in **2.C.1**, corrections on the top down data in **2.D.3**; error corrections in **2.I**).

One of the main reasons for revised emissions in NFR sector **3 Agriculture** was the application of the new Tier 2 NH₃ EF for mineral fertilizers according to the EMEP/EEA Guidebook 2023. Additionally, updated activity data has been included: new figures for the protein and fat content of milk for the year 2021 as well as updated figures on biogas plants became available. Methodological improvements of Statistics Austria resulted in shifts of livestock numbers between the cattle < 1 year sub-categories in the years 2003–2021.

In NFR sector **5 Waste**, revisions of activity data were carried out in categories *Solid waste disposal on land* (**5.A.1**), *Anaerobic digestion at biogas facilities* (**5.B.2**), *Open burning of waste* (**5.C.2**) and *Other waste* (**5.E**): New data on landfill gas recovery from a national study (**5.A.1**), updates of activity and nutrition data (N_{excretion} of cattle, biogas plants) (**5.B.2**), revised area of vineyards burnt from 2010 onwards (**5.C.2**) and updated statistical information on accidental building fires (**5.E**) were included.

For more detailed information see Chapter 7 – Recalculations and Improvements.

ES.6 IMPROVEMENT PROCESS

The Austrian Air Emission Inventory is subject to a continuous improvement programme resulting in annual recalculations (see Chapter ES.5 above). Furthermore, the regularly conducted reviews under the LRTAP Convention and the NEC Directive trigger improvements.

The last CLRTAP Stage 3 (“In-depth”) review of the Austrian Inventory took place in 2017 (United Nations, 2017). The findings for Austria are summarized and commented in Table 339. In 2022, an In-depth review of all Parties (so called ad-hoc Review) took place with a special focus on the condensable component of PM for sectors Residential heating and Transport. The recommendations for Austria are presented in Table 340. In 2023, the ad-hoc Review focused on Agriculture (emission inventories and gridded data). The recommendations for Austria are presented in Table 341.

In addition to the CLRTAP Review, from 2017 onwards the national emission inventory data is also checked by the European Commission as set out in Article 10 of Directive 2016/2284. The inventories are checked annually in order to verify the transparency, accuracy, consistency, comparability and completeness of information submitted and to identify possible inconsistencies with the requirements set out under international law, in particular under the LRTAP Convention. Synergies

are maximised with the 'Stage 3' reviews conducted by the LRTAP Convention. The findings under the NEC Review 2023 (EC, 2023a) and the National Air Pollution Projections Review 2023 (EC, 2023b) for Austria are summarized and commented in Table 342 and Table 343.

Recalculations and improvements are summarized in Chapter 7 – Recalculations and Improvements and described in detail in the sector-specific chapters of this report.

ES.7 CONDENSABLE COMPONENT OF PM₁₀ AND PM_{2.5}

The Parties to the LRTAP Convention have been formally requested by the Executive Body at its thirty-eight session to provide information on the reporting of the condensable component of particulate matter (PM) in their Informative Inventory Reports. The purpose is the provision of transparent information for the modellers. As a consequence, Annex II (Recommended structure for the Informative Inventory Report (IIR)) of the CLRTAP Reporting GL has been updated accordingly. Austria included the following information in its IIR from 2019 on:

- appendix including a table summarising whether PM₁₀ and PM_{2.5} emission factors for each source sector include or exclude the condensable component (and references for their emission factors) (see chapter 12.3).
- indication in the methodology sections whether PM₁₀ and PM_{2.5} emission estimates include or exclude the condensable component (please refer to the methodological chapters 3-6).

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