umwelt**bundesamt**ᵁ

ENVIRONMENT AGENCY AUSTRIA

AUSTRIA'S INFORMATIVE INVENTORY REPORT (IIR) 2022

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

SUMMARY – ACCESSIBLE FORMAT
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EXECUTIVE SUMMARY

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

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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-rage 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 ($PM_{2.5}$) 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 2020 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]

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[1]   According to the CLRTAP Reporting GL the reporting of total suspended particules (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/

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.

The emission data presented in this report were compiled according to the revised 2014 Reporting Guidelines (ECE/EB.AIR.125) that were approved by the Executive Body for the UNECE/LRTAP Convention at its 36th 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 SO_2, NO_x, VOC, NH_3 and $PM_{2.5}$. New emission reduction obligations will apply to anthropogenic emissions of these pollutants and, for the first time, 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 new 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 and the Kyoto Protocoll also requires the reporting of indirect GHGs (NO_x, CO, NMVOC) and SO_2 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 SO_2 emissions amounted to 74 kt. Since then emissions have decreased quite steadily. In the year 2020, emissions were reduced by 86% 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. The economic crisis in 2009 caused a decrease in emissions, followed by an increase due to the recovery of the economy. From 2019 to 2020 emissions decreased by 5.5%, mainly because in the iron and steel industry (1.A.2.a), which accounts for the largest share of SO_2 emissions (41%). SO_2 emissions from 1.A.2.a decreased by 5.3 % compared to 2019, due to the Covid pandemic. Compared to the previous year, SO_2 emissions also decreased in the public electricity and heat generation sector (1.A.1.a) and in the oil refinery sector (1.A.1.b). Among others, the phase-out

of coal is having an effect here. At the beginning of 2020, Austria's last coal-fired power plant in Mellach near Graz ceased operation.

In 1990, national total NO_x emissions amounted to 219 kt. After an all-time high of emissions between 2003 and 2005 emissions are decreasing continuously. This is mainly due to reduced emissions from heavy trucks, especially because of improvements in the after treatment technology. In 2020, NO_x emissions amounted to 124 kt and were about 43% lower than in 1990. From 2019 to 2020 emissions decreased by 14% due to the pandemic. The main reason was the reduction of passenger car mileage in sector 1.A.3.b.1 leading to a 11.7 kt reduction in emissions.

In 1990, national total NMVOC emissions amounted to 334 kt. Emissions have decreased steadily since then and in the year 2020 emissions were reduced by 67% to 111 kt compared to 1990. From 2019 to 2020 emissions increased by 2.1%, which was due to the increased use of disinfectants due to the pandemic. 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 (3.7%) of Austria's total NMVOC emissions. Reductions in the solvent sector have been achieved due to the Solvent Ordinance and the VOC Installation Ordinance.

In 1990, national total NH_3 emissions amounted to 69 kt; emissions have decreased over the period from 1990 to 2020. In 2020, emissions were 5.6% under 1990 level and amounted to 65 kt. NH_3 in Austria is almost exclusively emitted in the agricultural sector. The lower NH_3 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, emissions in 2020 decreased by 0.8%. The main reasons for this short-term decrease being, on the one hand, a smaller number of cattle (dairy cows: + 0.1 %; other cattle: − 1.8 %, cattle in total – 1.3 %) and on the other, a lower consumption of urea despite increasing mineral fertilizer consumption in total. Furthermore, NH_3 emissions from *1.A.3.b Road transport* fell by 18% below the previous years´ level as a result of the pandemic.

In 1990, national total CO emissions amounted to 1 254 kt. Emissions considerably decreased from 1990 to 2020. In 2020, emissions were 62% below 1990 levels and amounted to 475 kt. This reduction was mainly due to decreasing emissions from road transport (catalytic converters). The emissions decreased between 2019 and 2020 by 4.5%, mainly due to sector transport and iron and steel.

Particulate Matter

Particulate matter emissions in Austria mainly arise from industrial processes, road transport, agriculture and small heating installations.

Particulate matter (PM) emissions show a decreasing trend over the period 1990 to 2020: TSP emissions decreased by 31%, PM_{10} emissions were about 38% below the level of 1990, and $PM_{2.5}$ emissions dropped by about 51%. Between 2019 and 2020 TSP emissions decreased by 4.7%, PM_{10} by 4.8% and $PM_{2.5}$ by 5.4%. The short-term decrease of PM emissions was mainly due to pandemic-related reductions in the transport sector. In the transport sector PM emissions show a general decrease since several years as a result of improved technology.

Heavy Metals

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

The overall Cd emissions reduction of 46% from 1990 to 2020 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 reduction compared to the previous year 2019 was mainly due to lower emissions from *1.A.2 Manufacturing Industries and Construction (*Pulp, paper and print; other stationary combustion).

The overall reduction of Hg of about 59% for the period 1990 to 2020 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 in the industry sector, emissions dropped from 2006 onwards.

The overall reduction trend of Pb emissions was minus 95% for the period 1990 to 2020, 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 Pb emissions show a decrease of 11% mainly as a result of decreased emissions from *1.A.3.b Road Transportation (Automobile tyre and break wear)* and *Other product manufacture and use (NFR 2.G).*

Persistent Organic Pollutants (POPs)

Emissions of all POPs decreased remarkably from 1990 to 2020 (HCB -82%, PAH -65%, PCDD/F -73% and PCBs -57%), 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 2020 PCDD/F emissions decreased by 1.0% compared to the previous year 2019, PAH emissions increased by 0.4% and HCB emissions fell by 15% in the same time. This significant decrease of HCB emissions was mainly due to falling emissions from sectors *3.D.f Use of pesticides* and 2.*C.1 Iron and Steel Production*.

In 2020 PCB emissions decreased by 7.8% compared to the previous year 2019, due to lower emissions from *sector 2.C.1 Iron and Steel Production*.

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 NH_3 and PCB 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 2020.

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, TSP, PM_{10}, $PM_{2.5}$)
2.C.1 – Iron and Steel Production	14 times (Cd, Pb, Hg, DIOX, HCB, PCB, TSP, PM_{10}, $PM_{2.5}$)
1.A.3.b.1 – R.T., Passenger cars	11 times (NO_x, NMVOC, CO, Pb, TSP, PM_{10}, $PM_{2.5}$)
1.A.1.a – Public Electricity and Heat Production	13 times (SO_2, NO_x, Cd, Pb, Hg, DIOX, TSP, PM_{10}, $PM_{2.5}$)
1.A.3.b.3 – R.T., Heavy duty vehicles	6 times (SO_2, NO_x, 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. Also for the categories *1.A.1 Energy Industries* and *1.A.2 Manufacturing Industries*, the revisions follow those of the energy balance. Changes to NO_x and $PM_{2.5}$ emissions 2019 are mainly due to a revision of biomass consumption data. Recalculations of SO_2 emissions are mainly due to a revision of residual fuel oil as well as biomass consumption data.

For 1990 to 2019, minor changes in air pollutants emissions of categories Commercial/Institutional *(1.A.4.a)* and Residential *(1.A.4.b)* occur 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 in NFR *1.B.2.a.1 Transport of oil* (crude oil throughput) had to be converted from unit tonnes to unit cubic metres, resulting in revised NMVOC emissions over the whole time series.

In NFR sector **1.A.3 Transport**, the separate reporting of emissions from air-craft handling (*Airport ground activities*, NFR *1.A.3.e.2*), the entire time series of total annual fuel sales that flow into general road traffic emission modelling had to be updated. Furthermore, the stock of motorcycles has been updated from 2017 onwards correcting and adapting the NEMO model data set according to HBEFA version 4.1. Additionally, due to the relatively strong reductions in activity data in 2020 according to traffic counting points, it was necessary to calibrate the mileage of heavy duty trucks in 2019.

Recalculations in category *1.A.5 Other* result from the re-evaluation of data on kerosene consumption in response to a recommendation made by the UNFCCC 2020 on Austria's methodology for estimating emis-sions from military aviation 2000–2018.

In NFR sector **2 Industrial Processes and Product Use** the following recalculations have been carried out in subcategory *Solvent Use (2.D.3)*: The changes in the emission estimates result from updated activity data as well as newly included emission sources. Instead of reporting not estimated (NE), PM emissions from *Road paving with asphalt (2.D.3.b)* as well as PM and NMVOC emissions from *Asphalt Roofing (2.D.3.c)* are included in the current submission.

In category *Iron and Steel (2.C.1.)* measured data of both steel plants on emissions of heavy metals became available in 2021. This led to updated emissions of Cd, Hg, and Pb. Furthermore, due to updated activity data in the categories *Iron and Steel Production (2.C.1)* and *Wood processing (2.I)* recalculations have been carried.

The main reason for revised emissions in NFR sector **3 Agriculture** were due to a new research project on country-specific animal feeding and nutrition ("MiNutE" study, Hörtenhuber et al. 2022b) leading to updated and representative values for nitrogen and energy intake, excretion of nitrogen (N_{ex}) and volatile solids (VS_{ex}).

In NFR sector **5 Waste**, revisions werde made in categories *Biological treatment of waste (5.B)* and *Wastewater (5.D)*: Revisions in category *5.B* are due to new information on input materials for Austria's biogas plants (E-CONTROL, 2021), the update of nitrogen amounts of specific plant-based substrates as well as revised fermented manure quantities (VS-excretion and N-excretions) (see also sector 3 Agriculture). For NMVOC from category *5.D.1 Domestic Wastewater* recalculations have been carried out due to updated data on wastewater volumes 2019 as well as on the connection rate to the sewer system 2020.

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 331. The next Stage 3 review is currently not scheduled, but is expected within the next five years. For the period 2018-2021 the CLRTAP reviews focused on non-EU MS.

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 2021 (EC 2021a) and the National Air Pollution Projections Review 2021 (EC, 2021b) for Austria are summarized and commented in Table 332 and Table 333.

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 PM$_{10}$ 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 PM$_{10}$ 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 PM$_{10}$ and PM$_{2.5}$ emission estimates include or exclude the condensable component (please refer to the methodological chapters 3-6).