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-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 Ministry of Sustainability and Tourism (BMNT) 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 under 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 2017 for the main pollutants, for POPs and HMs and for the years 1990, 1995 and from 2000 onwards for PM.

From submission 2015 onwards, Austria reports all pollutants in the NFR14 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.

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.

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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: http://www.ceip.at/ms/ceip_home1/ceip_home/status_reporting/2014_submissions/

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 $PM_{2.5}$. Austria uses the national emission totals calculated on the basis of *fuel used* (thus excluding emissions from fuel exports in the vehicle tank) for compliance assessment under the NEC Directive.

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 2017, emissions were reduced by 82.6% compared to 1990 and amounted to 13 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. The strong reduction in emissions between 1991 and 1992 can be explained by reduced coal consumption in power plants (*1.A.1.a*) and a reduction of SO_2 emissions from oil fired power plants (*1.A.1.a*) as well as from iron and steel (*1.A.2.a*) and pulp and paper (1.*A.2.d*) production. From 2016 to 2017 emissions declined by 5.3%. This was mainly caused by reductions in emissions from iron and steel (*1.A.2.a*).

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 lower emissions from heavy duty vehicles influenced by declined fuel sales, fleet renewal and well-functioning NO_x exhaust after treatment systems. In 2017, NO_x emissions amounted to 145 kt and were about 34% lower than in 1990. From 2016 to 2017 emissions decreased by 4.4%. This was caused by the decline in road traffic, especially of heavy duty vehicles. In 2017 49% of the total nitrogen oxides emissions originate from road transport (including fuel exports). Austria is a landlocked country and fuel prices vary significantly between neighbouring countries. So Austria has experienced a considerable amount of 'fuel export' and the share of NO_x emissions caused by fuel sold in Austria but used abroad is notable. Emissions for 2017 based on fuel used amount to 131 kt and are about 13 kt lower than based on fuel sold; the decrease between 1990 and 2017 is slightly stronger.

In 1990, national total NMVOC emissions amounted to 324 kt. Emissions have decreased steadily since then and in the year 2017 emissions were reduced by 63% to 120 kt compared to 1990. The largest reductions were achieved in the road transport sector due to an increased use of catalytic converters and diesel cars. Reductions in the solvent sector were due to several regulations (Solvent Ordinance, Cogeneration Act, VOC Emissions Ordinance). From 2016 to 2017 emissions slightly decreased by 1.7%.

In 1990, national total NH_3 emissions amounted to 65.2 kt; emissions have increased over the period from 1990 to 2017. In 2017, emissions were 6.0% above 1990 levels and amounted to 69.1 kt. NH_3 in Austria is almost exclusively emitted in the agricultural sector. The higher NH_3 emissions (in spite of a decrease in the number of cattle) can be explained by an increase in loose housing systems (to ensure animal welfare and according to EU law) and an increase of high-capacity dairy cows. Additionally, there has been an increase in the use of urea as nitrogen fertiliser (a cost-efficient but otherwise less efficient fertiliser). Compared to the previous year, emissions in 2017 slightly rose by 1.1%. The main reason for this short-term increase is the larger number of dairy cows and their increased performance. Similarly, the livestock numbers of horses, swine, sheep and goats increased compared to the previous year.

In 1990, national total CO emissions amounted to 1 180 kt. Emissions considerably decreased from 1990 to 2017. In 2017, emissions were 55% below 1990 levels and amounted to 529 kt. This reduction was mainly due to decreasing emissions from road transport (catalytic converters). The emissions decreased slightly between 2016 and 2017 by 1.1%, mainly due to sectors non-metallic minerals (cement kilns) and road transportation.

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 2017: TSP emissions decreased by 24%, PM_{10} emissions were about 31% below the level of 1990, and $PM_{2.5}$ emissions dropped by about 41%. Between 2016 and 2017 PM_{10} and $PM_{2.5}$ emissions decreased slightly by 0.2% (PM_{10}) and 1.7% ($PM_{2.5}$), whereas TSP emissions showed a small increase (+0.6%). The minor short-term decrease of PM_{10} and $PM_{2.5}$ was mainly because of reductions in the energy and transport sectors (*1.A.3.b Road Transportation, 1.A.4.c.2 Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery*). TSP increased slightly due to rising emissions from *2.A.5.a Quarrying and mining of minerals other than coal*. Apart from industry and road transport, private households and the agricultural sector (soil cultivation and harvesting) are the main contributors to PM emissions.

Heavy Metals

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

The overall Cd emissions reduction of 31% from 1990 to 2017 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 emissions from iron and steel production. The increase compared to the previous year 2016 (+3.1%) was due to higher emissions from iron and steel industry.

The overall reduction of Hg of about 52% for the period 1990 to 2017 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. Several bans in different industrial sub-sectors and in the agriculture sector are behind these developments in Austria. Between 2016 and 2017 emissions increased by 7.6% mainly because of rising emissions from iron and steel industry, both process and pyrogenetic related.

The overall reduction trend of Pb emissions was minus 93% for the period 1990 to 2017, 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 an increase of 3.1% as a result of growing activities from iron and steel production.

Persistent Organic Pollutants (POPs)

Emissions of all POPs decreased remarkably from 1990 to 2017 (HCB -47%, PAH -61%, PCDD/F -67% and PCBs -19%), where the highest achievement was made until 1995. 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 2017 PCB emissions increased by 10% compared to the previous year 2016. This increase is dependent on production activities in iron and steel production.

PCDD/F emissions remained nearly at the same level in 2017 compared to the previous year 2016 (+0.9%), whereas PAH and HCB emissions slightly increased by 3.2% and 1.7%, respectively. This light increase is mainly due to higher emissions from the residential sector as a result of higher heating demand and thus higher biomass consumption as well as due to an increase of iron and steel production (relevant for HCB).

The most important source for PAH, PCDD/F and HCB emissions in Austria is residential heating. In the 80s 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. PCB emissions are almost exclusively emitted in NFR sector *2 Industrial Processes and Product Use* (Metal Production).

ES.4 Key categories

To determine key categories, a trend and a level assessment have been carried out, which resulted in 42 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 2017.

Name of key category	No of occurrences as key category
1.A.4.b.1 – Residential: stationary	24 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	15 times (Cd, Pb, Hg, DIOX, HCB, PCB, TSP, PM_{10}, $PM_{2.5}$)
1.A.3.b. – 1 R.T., Passenger cars	13 times (NO_x, NMVOC, CO, Pb, TSP, PM_{10}, $PM_{2.5}$)
2.A.5 – Mining, construction/demolition and handling of products	6 times (TSP, PM_{10}, $PM_{2.5}$)
1.A.2.a – Iron and Steel	4 times (SO_2, CO)

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. Natural gas gross inland consumption 2003 to 2004 and 2015 to 2016 has been revised downwards. Final energy consumption of natural gas for the period 2011–2016 has been changed too. Natural gas

consumption in private households 2005 to 2016 has been strongly revised upwards mainly due to a shift from the commercial sector (*1.A.4.a*) and for 2012 to 2016 also from the industrial sector (*1.A.2*) and the oil refinery (*1.A.1.b*). For 'other fuels' a major revision of the energy balance has taken place for the years 2005 to 2016, mainly for industrial waste. Following a recommendation of the NEC Review 2018, Cd, Hg, Pb, PCB and PAH emissions from category *Manufacture of Solid fuels and Other Energy Industries* (*1.A.1.c)* have been estimated. Methodological changes have been carried out in sectors *Non-metallic Minerals (1.A.2.f)* and *Other Stationary Combustion in Manufacturing Industries and Construction (1.A.2.g.viii)*.

In NFR sector *1.A.3 Transport*, an update of the inland diesel consumption lead to recalculations. The domestic diesel consumption has increased as a result of a methodological update for the use of mobile agricultural machinery (NRMM). In the model GEORG of the Graz University of Technology, the growth indicator "grain harvest" has been reanalysed and an improved method for the time series 2005–2016 has been implemented. In domestic road transport an update of the default probabilities for PC, LDV and HDV based on stock data after the year of their first registration by Statistik Austria has been implemented in the NEMO model from 2010 onwards.

According to the bottom-up / top-down methodology for the calculation of domestic fuel consumption and fuel exports, an increased use of domestic diesel always results in a reduction of the quantities handled in fuel export. As fuel export is mainly associated with truck traffic, the emission reduction is strongly reflected in subsector *1.A.3.biii Heavy duty trucks and buses*.

In NFR sector *2 Industrial Processes and Product Use* recalculations have been carried out due to updated activity data as a result of changes of the energy balance, the Montanhandbuch and electric steel plants production data for 2016 has been revised (2.C.1). On the other hand the revisions were due to methodological changes, largely due to the evaluation of the solvents model. A new set-up of the model on solvent use has been created. Reports on actual NMVOC emissions based on solvent balances, reported under Directive 1999/13/EC (VOC Solvents Directive) have led to significant improvements of the information on substance flows in the production segment (bottom-up approach), which were incorporated into the model.

For NFR sector *3 Agriculture* recalculations have been carried out due to update of activity data as well as methodological improvements. The research project 'Animal husbandry and manure management systems in Austria (TIHALO I, AMON et al. 2007)' was followed by a new study (TIHALO II, PÖLLINGER et al. 2018). For this project, as for the previous one, a comprehensive survey on agricultural practices in Austria has been carried out. For the 2019 submission the results of this survey (data on livestock feeding, management systems and practices, application techniques) were implemented in Austria's emission inventory resulting in revisions for NH_3 and NO_x emissions in all animal related emission sources. The methodological changes comprise largely improvements of the N-flow.

In NFR sector *5 Waste*, revisions were due to update of activity data in sectors Biological Treatment (5.B) and Other Waste (5.E). Emissions from biogas plants with feedstock from agriculture have been reported for the first time within sector 5.B. In sector 5.E an improved method for determining the number of fire incidents per category has been applied. Now the total number of fires is determined first, and then the fires in different types of housing or homes.

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 318. The next Stage 3 review is currently not scheduled, but will be within the next five years.

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 2018 for Austria are summarized and commented in Table 319.

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 2019:

- 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).