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 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 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 2018 for the main pollutants, for POPs and HMs and for the years 1990, 1995 and from 2000 onwards for PM.

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.

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 2018, emissions were reduced by 84.0% compared to 1990 and amounted to 12 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 2017 to 2018 emissions decreased by 8.4%. 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 217 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 2018, NO_x emissions amounted to 151 kt and were about 31% lower than in 1990. From 2017 to 2018 emissions decreased by 6.8%. This was caused by the decline in road traffic, especially of heavy duty vehicles and passenger cars. In 2018 53% of the total nitrogen oxides emissions originate from road transport (including fuel exports). Austria is a landlocked country and fuel prices significantly vary 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 2018 based on fuel used amount to 136 kt and are about 15 kt lower than based on fuel sold; the decrease between 1990 and 2018 is slightly stronger (-32%).

In 1990, national total NMVOC emissions amounted to 334 kt. Emissions have decreased steadily since then and in the year 2018 emissions were reduced by 68% to 107 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 2017 to 2018 emissions decreased by 3.2%.

In 1990, national total NH_3 emissions amounted to 62 kt; emissions have increased over the period from 1990 to 2018. In 2018, emissions were 4.7% above 1990 levels and amounted to 65 kt. NH_3 in Austria is almost exclusively emitted in the agricultural sector. The higher NH_3 emis-

sions (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 2018 decreased by 1.6%. The main reason is the lower amount of mineral fertilizer, in particular urea, which was applied on agricultural soils. Furthermore, the livestock numbers of cattle (dairy cows and other cattle) and swine were falling. However, increased N excretion due to increased milk yields counterbalanced the decreasing dairy cow number.

In 1990, national total CO emissions amounted to 1 249 kt. Emissions considerably decreased from 1990 to 2018. In 2018, emissions were 61% below 1990 levels and amounted to 490 kt. This reduction was mainly due to decreasing emissions from road transport (catalytic converters). The emissions decreased between 2017 and 2018 by 7.4%, mainly due to sectors iron and steel and residential (stationary).

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 2018: TSP emissions decreased by 28%, PM_{10} emissions were about 35% below the level of 1990, and $PM_{2.5}$ emissions dropped by about 48%. Between 2017 and 2018 PM_{10}, $PM_{2.5}$ and TSP emissions decreased by 4.3% (PM_{10}), 6.8% ($PM_{2.5}$) and 3.4% (TSP). The decrease of TSP, PM_{10} and $PM_{2.5}$ was mainly because of reductions in the sector *1 A 4 b 1 residential: stationary*, due to the mild weather in 2018 and a decrease in the use of biomass for heating. To a small extent, the latest decline can also be explained by efficiency improvements through thermal renovation and by a switch to modern biomass boilers and stoves (improvements in fuel combustion technologies). TSP emissions also decreased slightly due to reduced emissions from *2.A.5.a Quarrying and mining of minerals other than coal*.

Heavy Metals

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

The overall Cd emissions reduction of 35% from 1990 to 2018 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. In the last years emissions remained quite stable, the increased emission level 2017 was due to higher emissions from iron and steel production and from industrial processes.

The overall reduction of Hg of about 56% for the period 1990 to 2018 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 led to the sharp fall of total Hg emission in Austria by the year 2000. Between 2017 and 2018 emissions decreased by 7.0% mainly because of reduced emissions from NFR *2.C.1 Iron and Steel Production.*

The overall reduction trend of Pb emissions was minus 92% for the period 1990 to 2018, 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 6.2% as a result of reduced emissions from *Iron and Steel Production* (*2.C.1*).

Persistent Organic Pollutants (POPs)

Emissions of all POPs decreased remarkably from 1990 to 2018 (HCB -58%, PAH -64%, PCDD/F -73% and PCBs -32%), 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 2018 PCB emissions decreased by 16% compared to the previous year 2017, due to reduced emissions from *sector 2.C.1 Iron and Steel Production*.

PCDD/F emissions decreased by 7.5% compared to the previous year 2017, PAH emissions decreased by 8.1% and HCB emissions by 9.6% in the same time. These reductions are mainly due to the warm weather and thus reduced emissions from residential heating (decreased biomass consumption) as well as due to a decrease of iron and steel production (*2.C.1*) (relevant for HCB and PCDD/F). Dioxin/furan emissions from sector *Waste* (*5.E Other Waste)* also decreased remarkably from 2017 to 2018, although the share of this category in national total emissions is only 6%.

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. 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 43 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 2018.

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}, $PM_{2.5}$)
1.A.1.a – Public Electricity and Heat Production	18 times (SO_2, NO_x, NMVOC, CO, Cd, Pb, Hg, DIOX, TSP, PM_{10}, $PM_{2.5}$)
2.C.1 – Iron and Steel Production	14 times (Cd, Pb, Hg, DIOX, HCB, PCB, PM_{10})
1.A.3.b – 1 R.T., Passenger cars	12 times (NO_x, NMVOC, CO, TSP, PM_{10}, $PM_{2.5}$)
1.A.2.d – Pulp, Paper and Print	8 times (SO_2, Cd, Pb, Hg)

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 2014 and 2015 has been revised downwards. However, natural gas consumption has been shifted to different sectors. For liquid fuels, gross inland consumption has been revised downwards for the years 2005 to 2011 (crude oil input into refineries) and for the year 2017, which does not have an effect on final consumption, because lower fuel imports have been counterbalanced by higher refinery fuel output. For the period 2013 to 2017, liquid fuels have been shifted from the industry sector (mostly from 1A2e food processing and 1A2g other manufacturing industries) to the residential (1A4b) and commercial (1A4a) sector. For solid fuels, mainly the residential sector has been revised for the years since 2005. For 'biomass', gross inland consumption has been revised upwards for the whole time series 2005–2017. For the years 2005 to 2016, transformation input to the power sector (1A1a) has been revised downwards while for 2017 it has been revised upwards, which explains most of the higher NO_x (+7%) and $PM_{2.5}$ (+6%) emissions in 2017 of category 1A1a. The largest revision to biomass consumption took place in the 1A4 stationary combustion sub-categories.

In NFR sector *1.A.3 Transport*, the domestic activity data (fuel consumption/mileage) has been updated fundamentally with new specific mileage per vehicle category: for the first time, data from periodic roadworthiness testing has been evaluated resulting in new age-related mileage data and improved data accuracy. This affects the categories passenger cars (PC), light-duty vehicles (LDV) and motorcycles (MC). Furthermore, the new HBEFA Version 4.1 was implemented, which resulted in increased emission factors for all vehicle categories.

In NFR sector *2 Industrial Processes and Product Use* recalculations have been carried out mainly in subcategory Solvent Use (2.D.3): Following in-depth QC activities, time series inconsistencies in the solvents model were removed and has led to a decrease in activity data (Solvents Used), leading to a decrease in emissions.
In the categories Iron and Steel Production (2.C.1) and Other processes (2.H.2) estimates for the PAH fractions BAP, BBF, BKF, IND has been included.

More detailed statistical data became available on cigarettes sold in Austria, as well as loose tobacco and cigars, and was used for a review of the timeline.

Due to recalculations of the energy balances, the activity data in category Wood processing (2.I) had to be updated. Thus, particular matter emissions since 2005 have changed.

The main reason for revised emissions in NFR sector *3 Agriculture* is the implementation of the new EMEP/EEA Guidebook 2019 in category Manure Management (3.B). For mineral fertiliser application, rapid incorporation of urea into agricultural soils was considered for the first time. Inventory improvements resulted in lower NH_3 emissions over the whole time series.

In NFR sector *5 Waste,* the main revisions werde made in category Wastewater (5.D): For NMVOC from category *5.D.1 domestic wastewater* a recalculation for 2017 was carried out as new data on wastewater volumes became available. This new data was used to replace activity data that had been extrapolated based on population growth.

For more detailed information see Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** – 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 **Fehler! Verweisquelle konnte nicht gefunden werden.**. 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 **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Recalculations and improvements are summarized in Chapter **Fehler! Verweisquelle konnte nicht gefunden werden.** – 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 **Fehler! Verweisquelle konnte nicht gefunden werden.**).
- 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 **Fehler! Verweisquelle konnte nicht gefunden werden.**-**Fehler! Verweisquelle konnte nicht gefunden werden.**).