umweltbundesamt
ENVIRONMENT AGENCY AUSTRIA

Austria's Annual Air Emission Inventory 1990–2021

Emissions of SO_2, NO_x, NMVOC, NH_3 and $PM_{2.5}$

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INHALTSVERZEICHNIS

1 ZUSAMMENFASSUNG

Die aktuellen Ergebnisse der Österreichischen Luftschadstoff-Inventur zeigen 2021 gegenüber 2020 rückläufige NO_x-Emissionen und einen Anstieg der Emissionen bei SO_2, NMVOC, NH_3 und $PM_{2,5}$.

Die folgende Analyse bezieht sich auf die nationale Emissionsmenge inklusive Kraftstoffexport (berechnet auf Basis der verkauften Treibstoffmenge). Ab dem NEC-Bericht 2022 sind für das nationale Monitoring unter der NEC-Richtlinie (siehe Kapitel 3.2) die Emissionsmengen aus Kraftstoffexport nicht mehr von der Gesamtemissionsmenge abzuziehen.

- Die SO_2-Emissionen sind im Jahr 2021 gegenüber 2020 um 4,4 % angestiegen, was vor allem auf die Industrie (erhöhte Stahl- und Roheisenproduktion) und die stationären Quellen im Dienstleistungsbereich und den Haushalten (vermehrter Einsatz von Heizöl, Kohle und Brennholz auf Grund der kühleren Witterung) zurückzuführen ist. Den größten Anteil an den SO_2-Emissionen nimmt die Eisen- und Stahlindustrie mit 43,0 % ein. Hier stiegen die Emissionen gegenüber 2020 um 7,0 % bzw. 0,3 kt.
- Die NO_x-Emissionen sind verglichen mit 2020 im Jahr 2021 um ca. 1,5 % zurückgegangen. Hauptverantwortlich für die NO_x-Emissionen ist der Straßenverkehr. Für den rückläufigen Trend ist vor allem die Flottenerneuerung auf emissionsärmere Kfz im Pkw- und Lkw-Verkehr, die das Emissionsniveau trotz Fahrleistungssteigerung sinken lässt, verantwortlich.
- Von 2020 bis 2021 sind die NMVOC-Emissionen um 0,3 % leicht angestiegen. Diese stammen überwiegend aus der Landwirtschaft, dem Lösemittelsektor und der Bereitstellung von Raumwärme und Warmwasser in Privathaushalten. Während die Emissionen 2021 aus der Landwirtschaft nahezu unverändert geblieben sind, sind jene aus den Privathaushalten auf Grund der kühleren Witterung gestiegen. Gegenläufig, mit einer Abnahme von 6,2 %, sind jene des Lösemittelsektors, da die 2020 pandemiebedingt stark erhöhte Verwendung von Desinfektionsmitteln 2021 wieder deutlich gesunken ist.
- Die NH_3-Emissionen stammen nahezu ausschließlich aus dem Sektor Landwirtschaft (94,1 %). Im Jahr 2021 sind sie um ca. 0,5 % gegenüber 2020 gestiegen, wofür der etwas höhere Rinderbestand im Jahr 2021 verantwortlich war.
- Von 2020 auf 2021 sind die $PM_{2,5}$-Emissionen um 4,5 % gestiegen, hauptsächlich auf Grund des witterungsbedingt erhöhten Biomasseeinsatzes im Hausbrand.

Ab dem Jahr 2020 gelten entsprechend der EU-Emissionshöchstmengenrichtlinie (EU 2016/2284) bzw. dem Emissionsgesetz-Luft 2018 (EG-L 2018; BGBl. I Nr. 75/2018) neue Emissionsreduktionsverpflichtungen für die anthropogenen Emissionen von NO_x, SO_2, NMVOC, NH_3 und erstmals auch für Feinstaub ($PM_{2,5}$). Diese wurden im Jahr 2021 für die Luftschadstoffe NO_x, SO_2, NMVOC und $PM_{2,5}$ eingehalten. Die Emissionsmenge von NH_3 liegt hingegen um rund 6 %-Punkte darüber.

2 EINLEITUNG

Dieser Bericht beinhaltet eine Zusammenfassung des aktuellen Stands der Emissionen von Schwefeldioxid (SO_2), Stickstoffoxiden (NO_x), flüchtigen Kohlenwasserstoffen ohne Methan (NMVOC) und Ammoniak (NH_3) sowie der Feinstaubfraktion $PM_{2,5}$. Es werden die Emissionsdaten, die am 15. Februar 2023 an die Europäische Kommission übermittelt wurden, die wichtigsten Trends sowie die wesentlichen methodischen Änderungen gegenüber dem Vorjahr dargestellt.

- Annex 1 beinhaltet die Emissionen der Schadstoffe SO_2, NO_x, NH_3, NMVOC und $PM_{2,5}$ basierend auf dem inländischen Kraftstoffabsatz (Emissionen auf Basis „fuel sold").
- Annex 2 enthält die Emissionstrends dieser Schadstoffe abzüglich der Emissionsmengen aus preisbedingtem Kraftstoffexport in Fahrzeugen (Emissionen auf Basis „fuel used").

Die sektorale Gliederung der im Anhang präsentierten Überblickstabellen hält sich an die Berichtsnomenklatur (Nomenclature For Reporting, NFR) der United Nations Economic Commission for Europe (UNECE). Der vollständige Datensatz wurde in diesem Format an die Europäische Kommission übermittelt.

Der vorliegende Bericht wurde vom Umweltbundesamt auf Grundlage des Umweltkontrollgesetzes (BGBl. Nr. 152/1998) erstellt. Dem Umweltbundesamt wird in diesem Bundesgesetz in § 6 (2) Z. 19 unter anderem die Aufgabe übertragen, an der Erfüllung der Berichtspflichten an die Europäische Kommission gemäß Richtlinien und Entscheidungen der EU mitzuwirken. In § 6 (2) Z. 20 werden die Erstellung und Führung von Inventuren und Bilanzen zur Dokumentation des Zustandes und der Entwicklung der Umwelt sowie der Umweltbelastungen und ihrer Ursachen ausdrücklich als besondere Aufgaben des Umweltbundesamtes genannt.

Das Umweltbundesamt führt jährlich die Berechnung der Österreichischen Luftschadstoff-Inventur (OLI) durch, die als Grundlage für die Erfüllung der nationalen und internationalen Berichtspflichten herangezogen wird. Die OLI wird erforderlichenfalls auch für zurückliegende Jahre aktualisiert, um eine konsistente Zeitreihe zur Verfügung zu haben. Die in diesem Bericht publizierten Emissionsdaten ersetzen somit die publizierten Daten und Zeitreihen vorhergehender Berichte.

Stand der Daten und das Berichtsformat der vorliegenden Publikation:

Tabelle 1: Datengrundlage des vorliegenden Berichts.

Inventur	Datenstand	Berichtsformat
OLI 2022	07. Februar 2023	NFR-Format der UNECE

3 EMISSIONSTRENDS

In folgender Tabelle werden die aktuellen Ergebnisse der Österreichischen Luftschadstoff-Inventur (OLI) für die Emissionen von SO_2, NO_x, NH_3, NMVOC und $PM_{2,5}$ dargestellt.

Tabelle 2: NEC-Emissionen Österreichs, 1990–2021. (Quelle: Umweltbundesamt).

	Emissionen Österreichs [Kilotonnen]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2,5}$**
1990	73,70	218,95	334,05	69,27	27,26
1995	47,31	199,37	248,61	67,88	25,90
2000	31,52	212,63	181,41	64,15	24,33
2001	32,38	223,29	175,80	63,92	24,59
2002	31,28	231,11	170,88	62,93	23,69
2003	31,05	242,17	166,73	63,02	23,53
2004	26,57	242,21	153,43	62,66	22,94
2005	25,89	247,85	157,17	62,70	22,75
2006	26,66	238,31	159,21	63,01	22,20
2007	23,34	231,62	155,25	64,37	21,39
2008	20,27	218,68	150,09	63,73	20,53
2009	14,75	205,18	137,38	65,15	19,38
2010	15,99	206,02	137,90	65,15	19,89
2011	15,17	198,10	133,06	64,57	18,74
2012	14,79	193,33	130,79	64,82	18,28
2013	14,35	193,76	125,00	64,77	17,68
2014	14,52	186,71	118,35	65,47	16,17
2015	14,10	184,03	113,40	66,26	15,93
2016	13,27	176,51	112,19	67,17	15,55
2017	12,79	167,24	112,72	67,88	15,33
2018	11,59	154,97	108,73	66,84	14,21
2019	11,17	145,77	108,34	65,90	14,01
2020	10,41	124,47	110,53	65,53	13,35
2021	10,87	122,64	110,83	65,85	13,94

Demnach nahmen im Jahr 2021 gegenüber 2020 alle Luftschadstoffemissionen mit Ausnahme der NO_X-Emissionen wieder zu.

3.1 Beschreibung der Emissionstrends ab 1990

3.1.1 SO_2-Emissionen

2021 betrugen die SO_2-Emissionen 10,9 kt. Seit 1990 (73,7 kt) konnten die SO_2-Emissionen um 85,2 % reduziert werden. Seit 2005 sind sie um 58,0 % zurückgegangen. Das ist vorwiegend auf die Absenkung des Schwefelanteils in Mineralölprodukten und Treibstoffen (gemäß Kraftstoffverordnung), den Einbau von Entschwefelungsanlagen in Kraftwerken in den 1980er- und 1990er-Jahren (gemäß Luftreinhaltegesetz für Kesselanlagen) sowie auf die verstärkte Nutzung schwefelärmerer Brennstoffe, wie z. B. Erdgas, zurückzuführen.

Von 2020 auf 2021 sind die SO_2-Emissionen um 0,5 kt (+4,4 %) gestiegen. Vor allem in der Eisen- und Stahlindustrie (1.A.2.a), die mit 43,0 % den größten Anteil an den SO_2-Emissionen ausmacht, nahmen die Emissionen gegenüber 2020 um 7,0 % bzw. 0,3 kt zu. Dies ist im Wesentlichen auf die höhere Stahl- und Roheisenproduktion zurückzuführen. Bei den stationären Quellen der Dienstleistungen (1.A.4.a.1) und Haushalte (1.A.4.b.1) führte der höhere Einsatz von Heizöl, Kohle und Brennholz auf Grund der kühleren Witterung gegenüber dem Vorjahr zu einem Anstieg. Die SO_2-Emissionen der Erdölraffinerie (1.A.1.b) nahmen gegenüber 2020 auf Grund des höheren Rohöleinsatzes ebenfalls zu.

3.1.2 NO_X-Emissionen

Für das Jahr 2021 wurde ein Ausstoß von rund 122,6 kt NO_x berechnet. Im Jahr 1990 betrugen die NO_x-Emissionen 218,9 kt. Seither gingen sie um rund 44,0 % zurück. Seit 2005 wurde eine Emissionsreduktion um rund 50,5 % erzielt.

Der Rückgang der NO_x-Emissionen am Beginn der 1990er-Jahre ist überwiegend auf Maßnahmen im Bereich der Personenkraftwagen (1.A.3.b.1) sowie Minderungsmaßnahmen bei den großen Kohle- und Ölkraftwerken (1.A.1.a) und der Chemischen Industrie (2.B.10.a) zurückzuführen. Die Wirtschaftskrise war hauptverantwortlich für die Reduktion der NO_x-Emissionen von 2008 auf 2009.

Der überwiegende Anteil der nationalen NO_x-Emissionen entsteht bei der Verbrennung von Brenn- und Kraftstoffen, wobei der größte Anteil an den NO_x-Emissionen im Jahr 2021 mit 44,4 % auf den Straßenverkehr entfiel. In den Jahren 2003 bis 2005 erreichten die NO_x-Emissionen des Straßenverkehrs einen Höchstwert und gehen seither kontinuierlich zurück. Seit 2005 konnten sie um 65,0 % reduziert werden, wobei besonders die Emissionen des Schwerverkehrs durch Fortschritte in der Abgasnachbehandlung schwerer Nutzfahrzeuge (Lkw und Busse) zurückgingen.

Von 2020 auf 2021 kam es mit einer Reduktion um 1,8 kt bzw. 1,5 % zu einer leichten Abnahme der NO_x-Emissionen. Hierfür verantwortlich ist die Flottenerneuerung auf emissionsärmere Kfz im Pkw- und Lkw-Verkehr (1.A.3.b), die das Emissionsniveau trotz Fahrleistungssteigerungen sinken lässt. Bei den stationären Quellen der Dienstleistungen (1.A.4.a.1) und Haushalte (1.A.4.b.1) führte der

höhere Einsatz von Heizöl, Kohle und Brennholz auf Grund der kühleren Witterung gegenüber dem Vorjahr zu einem Anstieg der NO_x-Emissionen.

3.1.3 NMVOC-Emissionen

Die NMVOC-Emissionen betrugen im Jahr 2021 110,8 kt und im Jahr 1990 334,1 kt. Das entspricht einer Reduktion um 66,8 %. Seit 2005 konnten die NMVOC-Emissionen um 29,5 % reduziert werden. Von 2020 auf 2021 ist die Emissionsmenge um 0,3 kt (+0,3 %) leicht gestiegen.

Die größten Reduktionen seit 1990 konnten im Verkehrssektor erzielt werden, im Wesentlichen durch den verstärkten Einsatz von Katalysatoren und Diesel-Kfz. Aktuell nimmt der Straßenverkehr (1.A.3.b.) nur mehr einen geringen Anteil von 3,4 % an den gesamten NMVOC-Emissionen ein.

Im Lösemittelsektor (2.D.3) konnten auf Grund gesetzlicher Regelungen (Lösungsmittelverordnung sowie VOC-Anlagen-Verordnung) beachtliche Reduktionen erzielt werden. 2021 verursachte dieser Sektor rund 31,1 % der NMVOC-Emissionen. Gegenüber dem Vorjahr haben die Emissionen um 6,2 % abgenommen, was auf die nun wieder gesunkene Verwendung von Desinfektionsmitteln nach dem Covid-19-Pandemiejahr 2020 zurückgeführt werden kann.

Einen wesentlichen Anteil an den NMVOC-Emissionen hatte 2021 auch der Sektor Landwirtschaft (3) mit 31,9 % inne, wobei hier die Emissionsberechnung mit erheblichen Unsicherheiten verbunden ist. Die NMVOC-Emissionen stammen vorwiegend aus dem Wirtschaftsdüngermanagement (3.B) und zu einem geringeren Anteil aus Landwirtschaftlichen Böden (3.D). Im Vergleich zum vorherigen Jahr 2020 blieb das Emissionsniveau 2021 in der Landwirtschaft nahezu konstant (-0,1 %).

Die Bereitstellung von Raumwärme und Warmwasser in Privathaushalten (Hausbrand 1.A.4.b.1.) nimmt 2021 einen Anteil von 22,7 % der NMVOC-Emissionen ein. Auf Grund der kühlen Witterung 2021 nahm der Biomasseeinsatz deutlich zu, wodurch es im Vergleich zu 2020 zu einem Emissionsanstieg von 11,4 % kam. Vor allem veraltete Holzfeuerungsanlagen („Allesbrenner") sind in diesem Sektor weiterhin hauptverantwortlich für die relativ hohen Emissionen.

3.1.4 NH_3-Emissionen

Für das Jahr 2021 wurde eine Emissionsmenge von rund 65,8 kt NH_3 berechnet. Von 1990 bis 2021 nahmen die NH_3-Emissionen um 4,9 % ab. Seit 2005 ist allerdings ein Anstieg um 5,0 % zu verzeichnen.

Die Landwirtschaft ist mit einem Anteil von 94,1 % Hauptverursacher der österreichischen Ammoniak-Emissionen im Jahr 2021. Innerhalb des Sektors entstanden 2021 etwa 51 % der Emissionen aus dem Wirtschaftsdüngermanagement (3.B) und rund 49 % aus Landwirtschaftlichen Böden (3.D). Die Emissionen aus

der Landwirtschaft gingen seit 1990 um 7,0 % zurück. Neben dem rückläufigen Viehbestand wirkt sich die effizientere Fütterung der Tiere sowie der verstärkte Einsatz bodennaher Wirtschaftsdüngerausbringungstechniken (u. a. Schleppschlauch, Schleppschuh, rasche Einarbeitung von Gülle und Mist) günstig auf das Emissionsniveau aus.

Im Vergleich zu 2020 stiegen die NH_3-Emissionen Österreichs im Jahr 2021 um 0,3 kt an (+0,5 %). Hauptursache ist der erhöhte Rinderbestand 2021 (Milchkühe: +0,3 %; andere Rinder: +1,0 %; Rinder insgesamt: +0,8 %) im Sektor Landwirtschaft.

3.1.5 $PM_{2,5}$-Emissionen

Seit 1990 nahmen die $PM_{2,5}$-Emissionen um 48,9 % ab. Die Abnahme seit 2005 beträgt 38,7 %. Die größten Abnahmen seit 1990 gab es beim Hausbrand (1.A.4.b.1) wegen des stark reduzierten Kohleverbrauchs und beim Straßenverkehr (1.A.3.b) durch Verbesserungen bei den Antriebs- und Abgasnachbehandlungstechnologien (z. B. Partikelfilter).

Von 2020 auf 2021 sind die $PM_{2,5}$-Emissionen um 0,6 kt (+4,5 %) gestiegen, hauptsächlich auf Grund des witterungsbedingt erhöhten Biomasseeinsatzes im Hausbrand (1.A.4.b.1).

Der Hausbrand (1.A.4.b.1) nimmt 2021 mit rund 45,1 % den größten Anteil an den $PM_{2,5}$-Emissionen Österreichs ein. Der Anstieg um 9,4 % zwischen 2020 und 2021 ist eine Folge der kühleren Witterung 2021 und dem damit einhergehenden höheren Einsatz von Brennholz und Holzpellets für die Raumbeheizung. Zum Teil kann der insgesamt sinkende Trend der $PM_{2,5}$-Emissionen seit 2005 auch auf Effizienzverbesserungen durch thermische Sanierung und auf die Umstellung auf moderne Biomasseheizungen (Verbesserung der Verbrennungstechnologie) zurückgeführt werden.

3.2 Emissionsreduktionsverpflichtungen ab 2020

Seit dem Jahr 2020 gelten neue Emissionsreduktionsverpflichtungen für die anthropogenen Emissionen von NO_x, SO_2, NMVOC, NH_3 und erstmals auch für Feinstaub ($PM_{2,5}$). Sie sind in der EU-Richtlinie über die Reduktion der nationalen

Emissionen bestimmter Luftschadstoffe (kurz NEC-Richtlinie)[1] bzw. dem Emissionsgesetz-Luft 2018[2] festgelegt und gelten von 2020 bis 2029 und ab 2030. Die Mitgliedstaaten sind verpflichtet, diesen Emissionsreduktionsverpflichtungen jährlich nachzukommen und die Emissionen dieser fünf Schadstoffe entsprechend zu begrenzen.

Im Gegensatz zu den bis zum Berichtsjahr 2021 geltenden absoluten Emissionshöchstmengen für die Jahre 2010 bis 2019 sind die NEC-Ziele ab 2020 als Relativwerte festgelegt. Basisjahr für die Berechnungen der Emissionsreduktionsverpflichtungen ist das Jahr 2005.

In folgender Tabelle sind die ab 2020 geltenden Emissionsreduktionsverpflichtungen Österreichs dargestellt.

Tabelle 3: Nationale Emissionsreduktionsverpflichtungen gemäß NEC-Richtlinie für Österreich (Quelle: EG - L 2018, BGBl. I Nr. 75/2018).

	Nationale Emissionsreduktionsverpflichtungen gemäß NEC-Richtlinie	
Luftschadstoff	**Reduktion gegenüber 2005 in jedem Jahr zwischen 2020 und 2029**	**Reduktion gegenüber 2005 in jedem Jahr ab 2030**
NO_x	-37 %	-69 %
SO_2	-26 %	-41 %
NMVOC	-21 %	-36 %
NH_3	-1 %	-12 %
$PM_{2,5}$	-20 %	-46 %

Während für den Zielvergleich der Jahre 2010 bis 2019 die Emissionsmengen ohne Kraftstoffexport galten, werden für den Zielezeitraum ab 2020 die Gesamtemissionen Österreichs inklusive Kraftstoffexport (berechnet auf Basis der verkauften Treibstoffmenge) herangezogen. Dies ist in den Leitlinien für die Inventurberichterstattung[3] begründet. Dort ist vorgesehen, dass die Beurteilung der Zielerreichung grundsätzlich anhand der auf Basis der verkauften Treibstoffmenge berechneten Inventurdaten erfolgt. Jene Staaten, deren Verpflichtungen auf Basis der verbrauchten Treibstoffe festgelegt wurden, können aller-

[1] Richtlinie (EU) 2016/2284 des Europäischen Parlaments und des Rates vom 14. Dezember 2016 über die Reduktion der nationalen Emissionen bestimmter Luftschadstoffe, zur Änderung der Richtlinie 2003/35/EG und zur Aufhebung der Richtlinie 2001/81/EG, Anhang II. Nach der englischen Bezeichnung *National Emission Reduction Commitments Directive* bzw. der Bezeichnung der Vorgängerrichtlinie (*National Emission Ceilings Directive*) wird sie auch kurz NEC-Richtlinie genannt.

[2] Emissionsgesetz-Luft 2018 (EG-L 2018; BGBl. I Nr. 75/2018): Bundesgesetz über nationale Emissionsreduktionsverpflichtungen für bestimmte Luftschadstoffe (Emissionsgesetz-Luft 2018 – EG-L 2018)

[3] 2023 Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution. Diese Leitlinien sind auch unter der NEC-Richtlinie anzuwenden.

dings auch die auf Basis der verbrauchten Treibstoffmengen berechneten Inventurdaten als Grundlage für die Beurteilung der Zielerreichung wählen. Die Festlegung der ab 2010 geltenden Emissionshöchstmengen erfolgte in den späten 1990er-Jahren; damals war die Problematik des Kraftstoffexports im Fahrzeugtank noch nicht einmal erkannt worden. Die Festlegung der Emissionsreduktionsverpflichtungen für 2020 und 2030 basiert jedoch schon auf Modellrechnungen im Auftrag der Europäischen Kommission, bei denen der Kraftstoffexport in die österreichischen Daten eingerechnet wurde.

Die Emissionen von NO_x und NMVOC aus Tätigkeiten, die unter die Kategorien 3.B (Düngewirtschaft) und 3.D (Landwirtschaftliche Böden) fallen, sind im Rahmen der Reduktionsverpflichtungen nicht zu berücksichtigen und sind daher im Zielvergleich von den jeweiligen Gesamtemissionen abzuziehen.

Entsprechend Artikel 5 der NEC-Richtlinie werden den Mitgliedsstaaten gewisse Flexibilitätsregelungen und Anpassungsmöglichkeiten eingeräumt. Diese werden von Österreich im vorliegenden Bericht nicht angewandt.

Auf Basis der NEC-Emissionsberichterstattung 2023 stellt sich der Zielvergleich wie folgt dar:

- Für die Luftschadstoffe NO_x, SO_2, NMVOC und $PM_{2,5}$ werden die Emissionsreduktionsverpflichtungen für das Jahr 2021 eingehalten.
- Für Ammoniak (NH_3) wird das Reduktionsziel für das Jahr 2021 nicht erreicht (+5 % anstatt -1 % verglichen mit dem Basisjahr 2005).

Tabelle 4: Emissionen und prozentuelle Änderung von 2005 bis 2021 (Quelle: Umweltbundesamt).

	2005	**2021**	**2005–2021**
NO_x (ohne 3.B und 3.D)	237,09	111,63	-52,9 %
NMVOC (ohne 3.B und 3.D)	118,82	75,47	-36,5 %
SO_2	25,89	10,87	–58,0 %
NH_3	62,70	65,85	+5,0 %
$PM_{2,5}$	22,75	13,94	–38,7 %

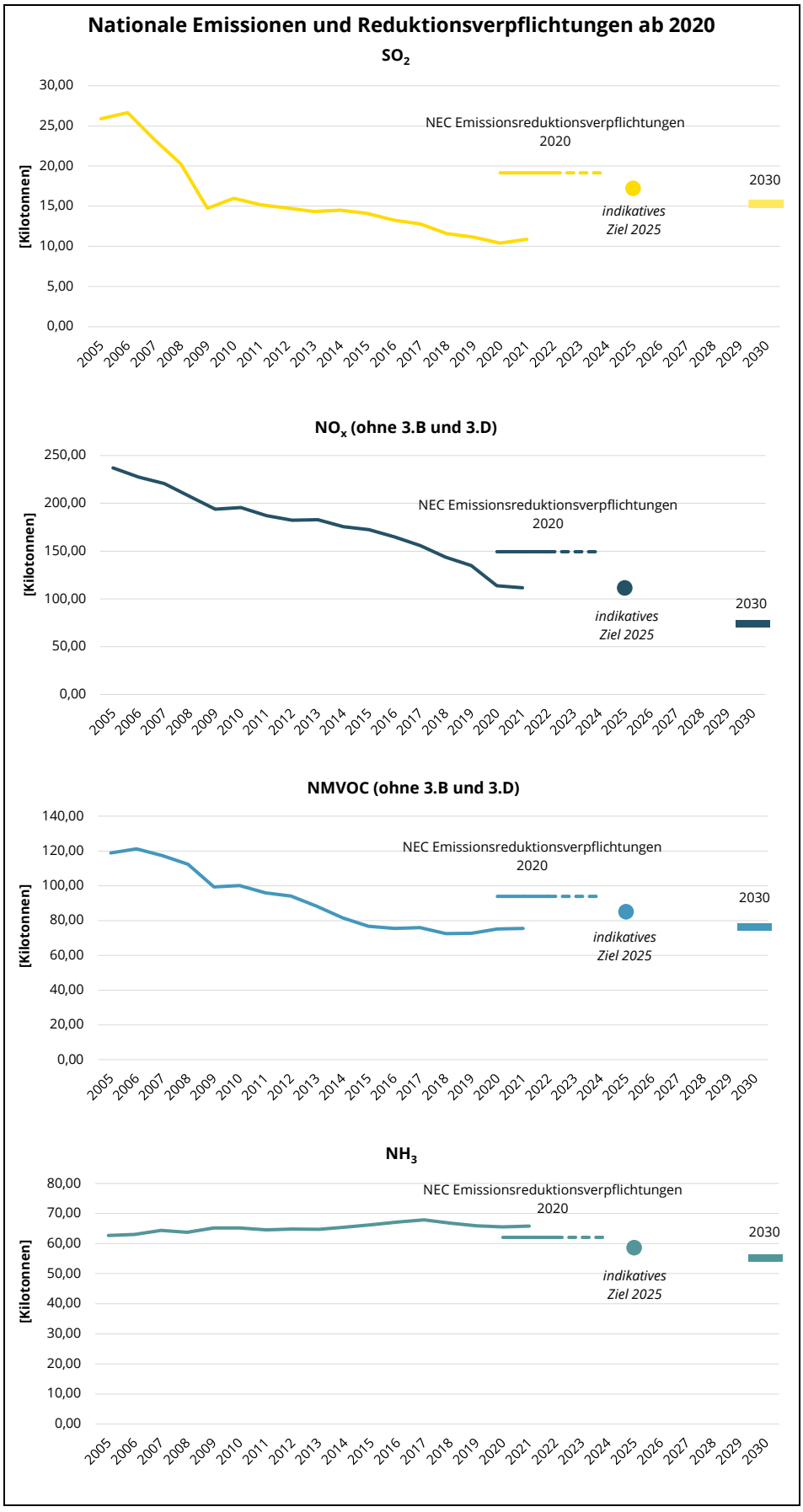
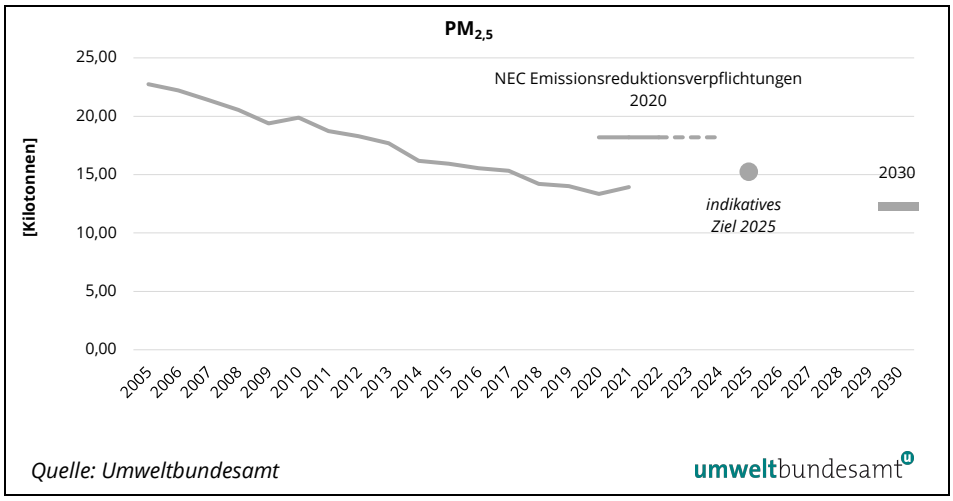


Abbildung 1: Gegenüberstellung der Emissionen und der Emissionsreduktionsverpflichtungen ab 2020 (Quelle: Umweltbundesamt).



3.3 Kraftstoffexport

Die Emissionsberechnungen für den Straßenverkehr basieren auf der in Österreich verkauften Treibstoffmenge. Allerdings wird nicht die gesamte Menge davon in Österreich verfahren, sondern ein Teil wird in den Fahrzeugtanks über die Landesgrenzen hinaus exportiert. Dieser Effekt wird „Kraftstoffexport" genannt.

Gründe für diesen Effekt sind strukturelle Gegebenheiten (Binnenland mit hohem Exportanteil in der Wirtschaft) sowie Unterschiede im Kraftstoffpreisniveau zwischen Österreich und seinen Nachbarländern.

Methodisch lassen sich die über die Grenzen verschobenen Kraftstoffmengen aus der Differenz zwischen Kraftstoffabsatz in Österreich und dem berechneten Inlandsverbrauch ermitteln. Davon können die Fahrleistungen (Kfz-km) von Pkw und schweren Nutzfahrzeugen abgeleitet werden und in weiterer Folge die zugehörigen Emissionen für den „Kraftstoffexport in Kraftfahrzeugen".

Nachstehende Tabelle zeigt die Emissionsmengen, die auf den Kraftstoffexport in Fahrzeugtanks zurückzuführen sind. Im Jahr 2021 sind 8,5 kt, rund 7,0 % der NO_x-Gesamtemissionen Österreichs, auf diesen Effekt zurückzuführen.

Ab Ende der 1990er-Jahre kam es – bedingt durch den zunehmenden Kraftstoffexport – zu einem verstärkten Anstieg der NO_x-Emissionen, vor allem im Schwerverkehr. Im Jahr 2005 wurde ein Höchstwert erreicht; seither nimmt der Kraftstoffexport kontinuierlich ab.

Tabelle 5: Emissionen aus Kraftstoffexport in Fahrzeugtanks. (Quelle: Umweltbundesamt).

	Emissionen in Kilotonnen				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2,5}$***
1990	0,78	16,88	4,50	0,05	0,55
1995	0,94	17,37	1,44	0,04	0,69
2000	0,53	31,82	0,29	-0,13	0,77
2001	0,64	39,46	1,48	0,01	0,97
2002	0,69	47,79	3,46	0,35	1,28
2003	0,74	54,41	4,46	0,54	1,51
2004	0,06	54,19	4,44	0,58	1,52
2005	0,05	57,01	4,50	0,63	1,58
2006	0,04	46,21	3,37	0,59	1,32
2007	0,04	43,12	3,09	0,60	1,23
2008	0,03	36,68	2,44	0,51	0,98
2009	0,04	35,75	2,25	0,51	0,91
2010	0,04	36,15	1,99	0,49	0,87
2011	0,03	29,08	1,53	0,40	0,67
2012	0,03	28,02	1,32	0,36	0,59
2013	0,04	31,46	1,21	0,32	0,58
2014	0,04	27,45	1,00	0,28	0,48
2015	0,04	26,24	0,97	0,29	0,44
2016	0,04	22,54	0,88	0,29	0,37
2017	0,04	20,27	0,78	0,28	0,32
2018	0,04	18,70	0,75	0,29	0,28
2019	0,04	17,00	0,67	0,29	0,24
2020	0,03	8,87	0,35	0,15	0,12
2021	0,03	8,54	0,38	0,17	0,11

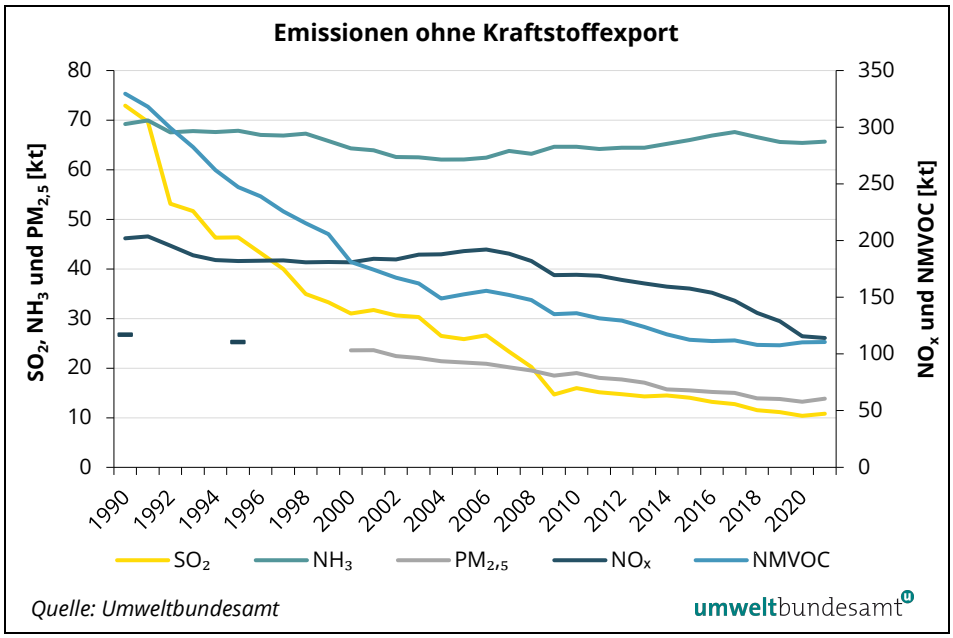
* *exkl. Brems-, Reifen-Abrieb und Aufwirbelung*

Die Emissionsmengen ohne Kraftstoffexport wurden für den Zielvergleich der Jahre 2010 bis 2019 herangezogen (EU-Emissionshöchstmengenrichtlinie, NEC-Richtlinie (EU) 2016/2284; Anhang IV).

Im Gegensatz dazu werden zur Überprüfung der NEC-Emissionsreduktionsverpflichtungen ab 2020 die Emissionsmengen auf Basis der verkauften Treibstoffe (also inkl. Kraftstoffexport) herangezogen.

Die folgende Abbildung zeigt die österreichischen Emissionen der Schadstoffe SO_2, NO_x, NH_3, NMVOC und $PM_{2,5}$ abzüglich der Emissionen aus dem Kraftstoffexport. Sie werden auf Basis des verbrauchten Kraftstoffs ("fuel used") ermittelt. Die Emissionswerte in tabellarischer Form sind im Anhang 2 angeführt.

Abbildung 2: SO_2, NO_x, NMVOC, NH_3 und $PM_{2,5}$-Emissionen ohne Kraftstoffexport.



4 INTRODUCTION

This report provides a summary of Austria's SO_2, NO_x, NH_3, NMVOC and $PM_{2.5}$ emissions for the years 1990 until 2021.

The following Annexes present trend tables for changes between 1990 and 2021 (SO_2, NO_x, NH_3, NMVOC and $PM_{2.5}$) for the main NFR sectors:

- Annex 1: national emission data on the basis of fuel sold;
- Annex 2: national emission data on the basis of fuel used.

The complete tables in the NFR format have been uploaded to the Central Data Repository (CDR)[4] of EIONET[5] as digital files (Excel).

[4] http://cdr.eionet.europa.eu/at/eu/nec

[5] European Environment Information and Observation Network (EIONET)

5 EMISSION TRENDS

The following table shows the current results of the Austrian Air Emission Inventory (OLI) for the emissions of SO_2, NO_x, NH_3, NMVOC und $PM_{2.5}$ for the years 1990 to 2021.

Table 1: Emissions in Austria, 1990-2021 (Source: Umweltbundesamt)

	Emissions in Austria [kilotonnes]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$**
1990	73.70	218.95	334.05	69.27	27.26
1995	47.31	199.37	248.61	67.88	25.90
2000	31.52	212.63	181.41	64.15	24.33
2001	32.38	223.29	175.80	63.92	24.59
2002	31.28	231.11	170.88	62.93	23.69
2003	31.05	242.17	166.73	63.02	23.53
2004	26.57	242.21	153.43	62.66	22.94
2005	25.89	247.85	157.17	62.70	22.75
2006	26.66	238.31	159.21	63.01	22.20
2007	23.34	231.62	155.25	64.37	21.39
2008	20.27	218.68	150.09	63.73	20.53
2009	14.75	205.18	137.38	65.15	19.38
2010	15.99	206.02	137.90	65.15	19.89
2011	15.17	198.10	133.06	64.57	18.74
2012	14.79	193.33	130.79	64.82	18.28
2013	14.35	193.76	125.00	64.77	17.68
2014	14.52	186.71	118.35	65.47	16.17
2015	14.10	184.03	113.40	66.26	15.93
2016	13.27	176.51	112.19	67.17	15.55
2017	12.79	167.24	112.72	67.88	15.33
2018	11.59	154.97	108.73	66.84	14.21
2019	11.17	145.77	108.34	65.90	14.01
2020	10.41	124.47	110.53	65.53	13.35
2021	10.87	122.64	110.83	65.85	13.94

Emissions of all the above pollutants have decreased since 1990. Compared to 2020, inventory results show increased emissions for all pollutants in 2021 except for NOx.

5.1 Description of trends since 1990

5.1.1 SO_2 emissions

In 2021, SO_2 emissions amounted to 10.9 kt. Since 1990 (73.7 kt), emissions have decreased by 85.2 % and since 2005 by 58.0 %.

This decline is mainly due to a reduction in the sulphur content in mineral oil products and fuels (as prescribed by 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 such as natural gas.

From 2020 to 2021, SO_2 emissions rose by 4.4 % (+0.5 kt), mainly because in the iron and steel industry (1.A.2.a), which accounts for the largest share of SO_2 emissions (43 %), the emissions rose by 7.0 % (+0.3 kt) as a result of increased production of pig iron and steel. Compared to the previous year, SO_2 emissions also increased significantly in the residential (1.A.4.b.1) and commercial/institutional heating sector (1.A.4.a.1) due to higher consumption of heating oil, coal and firewood (cooler weather compared to 2020). In the oil refinery sector (1.A.1.b) a rise of SO_2 emissions could also be observed.

5.1.2 NO_X emissions

In 1990, NO_x emissions amounted to 218.9 kt, and in 2021 to 122.6 kt, meaning a decrease of 44.0 % over the period. Since 2005, an emission reduction of about 50.5 % has been achieved.

The reduction in NO_x emissions at the beginning of the 1990s was mainly due to reductions in sector 1.A.3.b.1 (passenger cars), sector 1.A.1.a (large oil and coal power plants) and sector 2.B.10.a (chemicals industries). The economic crisis caused a decrease in emissions between 2008 and 2009.

The main share of Austria's national NO_x emissions is emitted by fuel combustion activities. At 44.4 %, road transportation accounted for the biggest share of Austria's total NO_x emissions in the year 2021. In the years 2003 to 2005, NOx emissions from road traffic peaked and have since then decreased continuously. They have been reduced by 65.0 %. In particular, emissions from heavy duty vehicles (trucks and busses) have fallen due to improvements in exhaust after-treatment technology.

Compared with 2020, national emissions in the year 2021 were 1.5 % (1.8 kt) lower. One of the reasons for this is the renewal of the fleet with low-emission vehicles in passenger car and truck traffic (1.A.3.b), which reduces the level of emissions despite an increase in mileage. Higher use of heating oil, coal and firewood from stationary combustion of commercial/institutional (1.A.4.a.1) and households (1.A.4.b.1) led to an increase in NOx emissions due to the cooler weather compared to the previous year.

5.1.3 NMVOC emissions

Non-methane volatile organic compounds emissions amounted to 334.1 kt in 1990 and to 110.8 kt in 2021. This corresponds to a reduction of 66.8 %. From 2020 to 2021, NMVOC emissions increased by 0.3 kt (+ 0.3 %).

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 (3.4 %) of Austria's total NMVOC emissions.

Reductions in the solvent sector (2.D.3) have been achieved due to the Solvent Ordinance and the VOC Installation Ordinance. In 2021, the solvent sector accounted for around 31.1 % of Austria's total NMVOC emissions. Compared to the previous year, emissions decreased by 6.2 %, which was due to the decreased use of disinfectants compared to the pandemic year 2020.

The agriculture sector (3) accounted for a significant share of NMVOC emissions at 31.9 % in 2021; however, emission calculations for this sector are considerably uncertain. Here, NMVOC emissions originate mainly from manure management (3.B) and to a lesser extent from agricultural soils (3.D). Compared to the previous year, emissions from agriculture remained quite stable in 2021 (-0.1 %).

Residential stationary heating (1.A.4.b.1.) accounted for 22.7 % of the total 2021 NMVOC emissions. Emissions from this sector increased significantly between 2020 and 2021 (+11.4 %), mainly due to a considerably higher level of biomass used for heating because of the colder weather. Outdated mixed-fuel wood boilers continue to be the main source of the relatively high emissions.

5.1.4 NH_3 emissions

Ammonia emissions amounted to 65.8 kt in 2021. Since 1990, NH_3 emissions have decreased by 4.9 %, although since 2005 they have increased by 5.0 %.

The main source of NH_3 emissions is the agriculture sector with a share of 94.1 % in 2021. Within the agriculture sector about 51 % of NH_3 emissions result from Manure Management (3.B) and 49 % from Agricultural Soils (3.D). There was a decrease of 7.0 % in NH_3 emissions from the agriculture sector between 1990 and 2021. This reduction can be mainly 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 2020, total emissions increased by 0.3 kt (+0.5 %). The main reasons for this light short-term increase is the slightly larger number of cattle (dairy cows: +0.3 %; other cattle: +1.0 %, cattle in total +0.8 %).

5.1.5 $PM_{2.5}$ emissions

Since 1990, $PM_{2.5}$ emissions have decreased by 48.9 %. The decrease since 2005 is estimated at 38.7 %.

The largest reductions were achieved through reduced coal consumption in households (1.A.4.b.1) and improved vehicle exhaust after-treatment technologies in road transport (1.A.3.b).

From 2020 to 2021, $PM_{2.5}$ emissions increased by 0.6 kt (+4.5 %), due to higher biomass consumption from residential heating (1.A.4.b.1) because of the colder weather and the higher heating demand.

With a share of about 45.1 %, sector 1.A.4.b.1 residential: stationary was the main source of total $PM_{2.5}$ emissions in 2021. The change in emissions between 2020 and 2021 by +9.4 % was due to the increased volume of biomass used for heating because of the colder weather in 2021. To some extent, the overall decreasing trend of 1.A.4.b.1 stationary residential heating since 2005 can also be explained by efficiency improvements through thermal renovation and a switch to modern biomass boilers and stoves (improvements in fuel combustion technologies).

5.2 Emission reduction obligations as of 2020

From 2020 onwards, new emission reduction obligations will apply to anthropogenic emissions of NO_x, SO_2, NMVOC, NH_3 and, for the first time, particulate matter ($PM_{2.5}$). These are set out in the EU Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (NEC Directive for short)[6] and the national Air Emissions Act 2018[7], respectively, and apply from 2020 to 2029 and from 2030 onwards. The Member States are obliged to comply with these emission reduction obligations annually and to limit the emissions of these five pollutants accordingly.

In contrast to the absolute emission ceilings for the years 2010 to 2019, which applied until the reporting year 2021, the NEC targets for the years 2020 onwards are set as relative values compared to base year values. The base year for the calculations of the emission reduction commitments is 2005.

The following table shows Austria's emission reduction commitments that apply for the years 2020 onwards.

[6] Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC

[7] Air Emissions Act (Emissionsgesetz-Luft) 2018 (EG-L 2018; BGBl. I Nr. 75/2018): Bundesgesetz über nationale Emissionsreduktionsverpflichtungen für bestimmte Luftschadstoffe (Emissionsgesetz-Luft 2018 – EG-L 2018)

Table 2: National Emission reduction commitments under the NEC Directive for Austria (Source: EG - L 2018, https://www.ris.bka.gv.at/eli/bgbl/l/2018/75).

	National Emission reduction commitments under the NEC Directive	
Atmospheric pollutant	**Reduction compared with 2005 for any year from 2020 to 2029**	**Reduction compared with 2005 for any year from 2030**
NO_x	– 37 %	– 69 %
SO_2	– 26 %	– 41 %
NMVOC	– 21 %	– 36 %
NH_3	– 1 %	– 12 %
$PM_{2.5}$	– 20 %	– 46 %

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. This is justified in the inventory reporting guidelines[8]. It provides that the assessment of the achievement of the target is, in principle, based on the inventory data calculated on the basis of the quantity of fuel sold. However, those States whose obligations have been determined on the basis of the fuel consumed may also choose the inventory data calculated on the basis of the quantities of fuel used as the basis for assessing the achievement of the target. The emission ceilings applicable from 2010 onwards were established in the late 1990s; at that time, the problem of fuel export in the vehicle tank had not even been recognised. However, the setting of emission reduction commitments for 2020 and 2030 is based on model calculations made on behalf of the European Commission, where fuel exports have been considered in the respective Member State targets.

The emissions of NO_x and NMVOC from activities falling under categories 3.B (manure management) and 3.D (agricultural soils) are not to be taken into account in the context of the reduction obligations and should therefore be deducted from the respective total emissions.

In accordance with Article 5 of the NEC Directive, Member States will be given some flexibility and adaptation possibilities. These are not applied by Austria in the present report.

Based on 2023 NEC emissions reporting, the compliance with the 2021 targets is as follows:

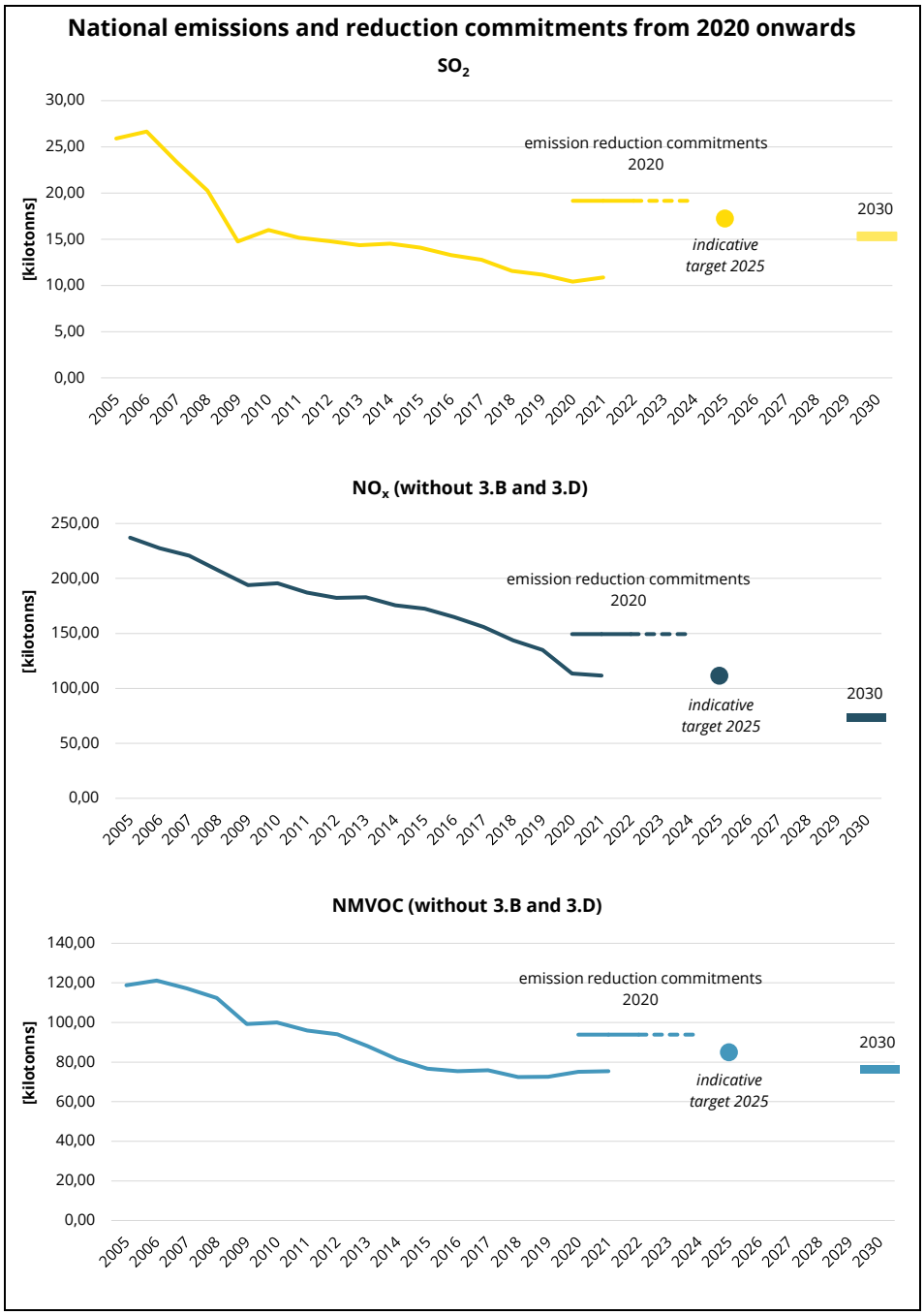
- For the air pollutants NO_x, SO_2, NMVOC and $PM_{2.5}$ the national emission reduction commitments for the year 2021 are met.
- For ammonia (NH_3), the national emission reduction commitment for 2021 is not met (+ 5 % instead of - 1 % compared to the base year 2005).

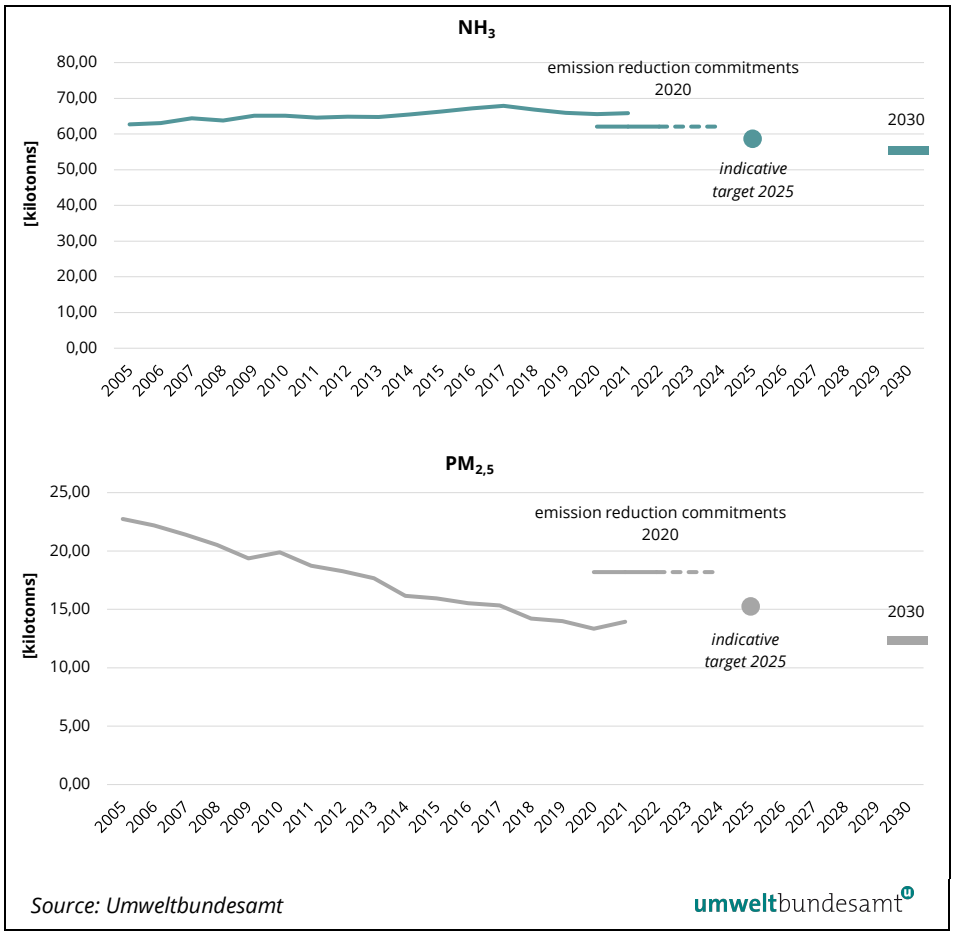
[8] 2023 Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution. These guidelines are also applicable under the NEC Directive.

Table 3: Emissions and the percentage change from 2005 to 2021 (Source: Umweltbundesamt).

	2005	2021	2005-2021
NO_x (without 3.B and 3.D)	237.09	111.63	-52.9%
NMVOC (without 3.B and 3.D)	118.82	75.47	-36.5%
SO_2	25.89	10.87	– 58.0 %
NH_3	62.70	65.85	+ 5.0 %
$PM_{2,5}$	22.75	13.94	– 38.7 %

Figure 1: Comparison of emissions with emission reduction commitments from 2020 onwards.





5.3 Fuel export

The emission calculations for the sector road transport in this submission are based on the quantity of fuel sold in Austria. However, the fuel quantity sold is not completely used in Austria with part of it exported in the vehicle tanks and combusted beyond the national borders. This effect is called "fuel export".

The reasons for this effect are structural conditions (Austria is a landlocked country with a high share of exports in the economy) and differences in fuel price levels between Austria and its neighboring countries.

The quantities of fuel exported (and used) abroad can be determined from the difference between fuel sales in Austria and the calculated domestic consumption. From this, the mileage (car-km) can be derived from cars and heavy-duty vehicles and, subsequently, the associated emissions for "fuel exports in motor vehicles".

The table below shows the emissions due to fuel exports. In 2021, 8.5 kt, around 7.0 % of Austria's total NO_x emissions, are due to this effect.

From the end of the 1990s, there was an increase in NO_x emissions, mainly from heavy-duty vehicles due to increased fuel exports. A peak was reached in 2005; since then, fuel exports have declined continually.

Table 4: Emissions from fuel exports. (Source: Umweltbundesamt).

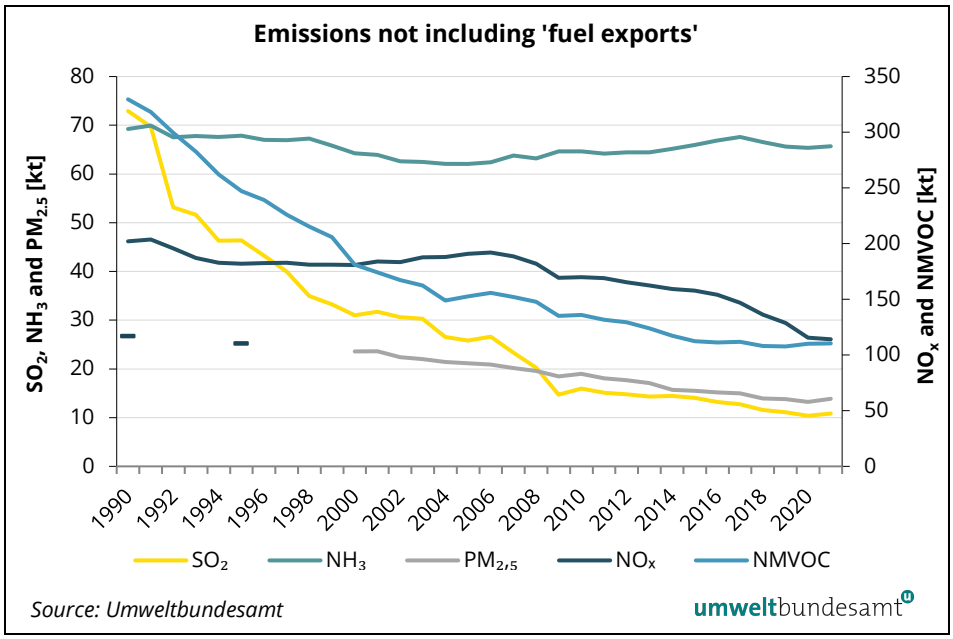
	Emissions in [kilotonnes]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$***
1990	0.78	16.88	4.50	0.05	0.55
1995	0.94	17.37	1.44	0.04	0.69
2000	0.53	31.82	0.29	-0.13	0.77
2001	0.64	39.46	1.48	0.01	0.97
2002	0.69	47.79	3.46	0.35	1.28
2003	0.74	54.41	4.46	0.54	1.51
2004	0.06	54.19	4.44	0.58	1.52
2005	0.05	57.01	4.50	0.63	1.58
2006	0.04	46.21	3.37	0.59	1.32
2007	0.04	43.12	3.09	0.60	1.23
2008	0.03	36.68	2.44	0.51	0.98
2009	0.04	35.75	2.25	0.51	0.91
2010	0.04	36.15	1.99	0.49	0.87
2011	0.03	29.08	1.53	0.40	0.67
2012	0.03	28.02	1.32	0.36	0.59
2013	0.04	31.46	1.21	0.32	0.58
2014	0.04	27.45	1.00	0.28	0.48
2015	0.04	26.24	0.97	0.29	0.44
2016	0.04	22.54	0.88	0.29	0.37
2017	0.04	20.27	0.78	0.28	0.32
2018	0.04	18.70	0.75	0.29	0.28
2019	0.04	17.00	0.67	0.29	0.24
2020	0.03	8.87	0.35	0.15	0.12
2021	0.03	8.54	0.38	0.17	0.11

The national emissions without fuel exports were used to assess compliance with the emission ceilings under the NEC Directive for the years 2010 to 2019 (EU Emission Ceilings Directive, NEC Directive (EU) 2016/2284; Annex IV).

But from 2020 onwards the emissions based on fuels sold (i.e. including fuel exports) are used for assessing the compliance with the relevant national emission reduction commitments.

The following figure shows the Austrian emissions of the pollutants SO_2, NO_x, NH_3, NMVOC and $PM_{2.5}$ without emissions from fuel exports. They are determined on the basis of the fuel used. The emission values in tabular form are listed in Annex 2.

Figure 2: SO_2, NO_x, NMVOC, NH_3 and $PM_{2.5}$-emissions without fuel exports.



6 METHOD OF REPORTING

6.1 Methodology

The Austrian air emission inventory for the period 1990 to 2021 has been compiled according to the 2023 Guidelines for Reporting Emissions and Projections Data as adopted by the Executive Body for the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP Convention) at its 42nd session.

In Austria, emissions of air pollutants as well as emissions of greenhouse gases are all gathered in a database based on the CORINAIR nomenclature (CORe INventory AIR)/SNAP (Selected Nomenclature for sources of Air Pollution). This nomenclature was designed by the EEA to estimate emissions of all kinds of air pollutants. To comply with the reporting obligations under the UNECE/LRTAP Convention, emissions are then transformed into the NFR (Nomenclature for Reporting) format.

The complete set of tables in the NFR format, including – in particular – sectoral reports and sectoral background tables, is submitted separately in digital form only (Excel files). In this report, NFR summary tables are presented in Annexes 1 and 2.

The following table summarises the status of this report:

Table 5: Status of report.

Format	Inventory	Version
NFR Format (UNECE)	OLI 2022	February 7th 2023

Data presented in this report are based on the Austrian Air Emission Inventory 2022 (Österreichische Luftschadstoff-Inventur, OLI 2022) prepared by the Umweltbundesamt in the year 2022 with annual emissions estimates for the years between 1990 and 2021. The Austrian air emission inventory is subject to continuous improvement, resulting in recalculations as outlined in Chapter 7.

6.2 Sources of Data

Table 6 presents the main data sources used for activity data as well as information on the institutions that carried out the actual calculations.

Table 6: Main data sources for activity data and emission values.

Sector	Data Sources for Activity Data
Energy	Energy Balance from Statistik Austria; EU-ETS; LCP emission declarations; direct information from industry or associations of industry; energy demand model for space heating (fuel technology shares)
Transport	Energy Balance from Statistik Austria; yearly new vehicle registrations from Statistik Austria; yearly growth rates of transport performance on Austrian roads from Federal Ministry of Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK); ZBD: Zentrale Beguchtachtungs Datenbank (periodically updated specific mileage); yearly flight movements from AustroControl; yearly FC of airport ground activities at Vienna International Airport
IPPU	National production statistics, import/export statistics; direct information from industry or associations of industry; Surveys conducted at companies and associations; Reports submitted under the Industrial Emissions Directive
Agriculture	National studies; national agricultural statistics obtained from Statistik Austria; national fertiliser statistics, protein content and fat content of milk obtained from Agrarmarkt Austria (AMA); national statistics on cattle breeding obtained from Rinderzucht Austria; distributing company (sales data)
Waste	Federal Waste Management Plans (Data sources: Database on landfills (1998–2007), EDM – Electronic Data Management (from 2008 onwards)); EMREG-OW (Electronic Emission Register of Surface Water Bodies)

Emission calculations and related inventory work (reporting, QA/QC, documentation and archiving, etc.) are carried out by sector experts of the Inspection Body for Emission Inventories (IBE).

In cases which exceed the IBE's resources, the IBE concludes service contracts with qualified institutions (particularly universities or research institutes).

The IBE is responsible for

- choice of the contractor i.e. judging his/her expertise with regard to the technical and QMS requirements
- specifying the technical and QMS requirements in the service contract
- performing and documenting a detailed QC check of the results i.e. checking if the specified requirements were fulfilled
- implementation of the results into the emission inventory in line with the technical and QMS requirements particularly the requirement of full reproducibility of the emission inventory

Service contracts have been entered into with e.g.:

- Technical University Graz (road and off-road transport)
- University of Natural Resources and Applied Life Sciences (agriculture)

All relevant service contracts are referenced in the sector specific chapters of the IIR.

A detailed description of the activity data, emission factors, and the methodologies applied will be provided in Austria's Informative Inventory Report (IIR) 2023[9], which is to be submitted under the UNECE Convention on Long-range Transboundary Air Pollution and the NEC-Directive (EU 2016/2284) on 15 March 2023.

[9] https://www.umweltbundesamt.at/emiberichte

7 RECALCULATIONS

Following the continuous improvements made to Austria's annual Air Emission Inventory, some sources have been recalculated on the basis of updated activity data or revised methodologies. Thus, the emission data for the period from 1990 to 2020 submitted this year may differ from the data previously reported.

The figures presented in this report replace former data reported by the Umweltbundesamt under the reporting framework of the UNECE/LRTAP Convention and the NEC Directive of the European Union.

Table 7: Recalculation difference with respect to the previous submission (Source: Umweltbundesamt).

	Recalculation Difference [%]		
	1990	**2005**	**2020**
SO_2	0.00 %	– 0.18 %	– 1.24 %
NO_x	– 0.02 %	0.02 %	0.29 %
NMVOC	– 0.13 %	0.21 %	– 0.27 %
NH_3	0.00 %	– 0.57 %	0.17 %
$PM_{2.5}$	0.57 %	0.88 %	0.73 %

There have been recalculations carried out in all sectors, largely due to updated activity data, e.g. the revision of the energy balance, production amounts and livestock data. Furthermore, methodological improvements such as the usage of updated emission factors, have also led to revisions.

The following section describes the methodological changes made to each sector of the inventory since the previous submission.

7.1 ENERGY (1)

7.1.1 Stationary combustion 1.A.1.a-c, 1.A.2.a-g, 1.A.3.e.i and 1.A.4.a-1.A.4.c

7.1.1.1 Update of activity data

Revision of the energy balance

The federal statistics office "Statistik Austria" revised the energy balance (mainly for year 2020) with the following **main implications** for energy consumption as used in the inventory:

- Natural gas 2020: Gross inland consumption has been revised by +1.5 PJ and allocated to final energy consumption, of which 0.8 PJ has been allocated to *1.A.2* (+0.19 PJ for *1.A.2.a*, +0.09 PJ for *1.A.2.b*, +0.42 PJ for *1.A.2.c*,

+0.50 PJ for 1.A.2.d, +0.25 PJ for *1.A.2.e*, -0.65 PJ for *1.A.2.g*). Another 0.7 PJ of final consumption has been allocated to *1.A.4* (mainly to *1.A.4.b.1*).

- Gasoil 2020: Minor shifts between *1.A.2* (-0.06 PJ), *1.A.4.a* (-0.29 PJ) and *1.A.4.b* (+0.43 PJ)
- LPG 2020: Minor shifts from non-energy use (-0.07 PJ) to *1.A.4.b.1*.
- Hard coal 2020: 0.2 PJ have been shifted from *1.A.4.b.1* residential to *1.A.2.f* non-metallic minerals industry.
- Coke oven coke 2020: 0.06 PJ have been shifted from *1.A.4.b* to *1.A.2.a* final consumption.
- Solid biomass: 0.07 PJ of fuel wood has been shifted from *1.A.4.c* agriculture to *1.A.4.a* commercial. For the years 2018-2020, 0.05 to 0.3 PJ have been shifted between *1.A.2* and *1.A.4* sub categories.

7.1.1.2 Methodological Changes

Energy Industries (1.A.1) and Manufacturing Industries (1.A.2)

For the categories 1.A.1 and 1.A.2, the revisions follow those of the energy balance. The methods applied (emissions factors and data sources) remain unchanged. The changes to the 1.A.2.a NMVOC emissions for 2020 (-0.1 kt) are due to an error correction.

Other Sectors (1.A.4)

For 1990 to 2020, minor changes in air pollutant 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).

7.1.2 Fugitive emissions (1.B)

7.1.2.1 Distribution of oil products (1.B.2.a.v)

Activity data (gasoline) and NMVOC emissions from NFR *1.B.2.a.v Distribution of oil products* were revised for the years 2010 to 2020 (NMVOC 2020: -0.004 kt) due to the change of calculation by one data supplier. Through this change, an overall harmonised approach of reporting was achieved among the data suppliers.

7.1.2.2 Fugitive emissions from natural gas (1.B.2.b)

NMVOC emissions from NFR *1.B.2.b Natural Gas* had to be revised over the whole time series due to the correction of a calculation error and the use of updated data on the composition of natural gas in the area of natural gas distribution. Furthermore the NMVOC emission from gas extraction 2020 was corrected

by the Austrian association of oil industry. The overall effect of these revisions is +0.16 kt NMVOC emissions in 2020.

7.1.3 Transport (1.A.3)

Road Transport (1.A.3.b)

Update of activity data

- **Update of specific vehicle mileage per year**
  A statistical evaluation of the specific annual mileage from the central assessment database (ZBD - annual "sticker check" in accordance with §57a KFG) for the years 2018, 2019 and 2020 was carried out for passenger cars, light duty vehicles, buses and 2-wheelers. The revision of this data resulted in a shift between inland vehicle kilometres and mileage of vehicles in the category fuel export (mainly HDV). In detail, the ZBD data shows that there was an overestimation of inland vehicle kilometres in 2018 and 2019 by the model and an underestimation of inland vehicle kilometres in the pandemic year 2020. This has been corrected accordingly in this year's submission.

Methodological changes

- **Update of fuel consumption and emission factors according to HBEFA Version V4.2**
  Update of hot emission factors and characteristic motor curves for EURO 6 passenger cars and EURO VI HDV trucks. Adaptation of the fleet data to HBEFA V4.2 (HDV EUROVI_ABC_DE). Update of aging factors for cars and HDV.

All these changes resulted in recalculations in *1.A.3.b. Road Transport* for 2020 of +0.5 kt NO_x, -0.01 kt SO_2, -0.01 kt NH_3, -0.12 kt NMVOC, +1.5 kt CO and +0.02 kt $PM_{2.5}$.

7.2 INDUSTRIAL PROCESSES (2)

7.2.1 Update of activity data

7.2.1.1 Copper production (2.C.7.a)

Activity data from 2010 onwards were updated (e.g. + 0.00003 kt $PM_{2.5}$ and + 0.02 kt SO_2 in 2020).

7.2.1.2 Road paving with asphalt (2.D.3.b)

Activity data for 2020 were updated (- 0.0002 kt $PM_{2.5}$, - 0.0015 kt NMVOC).

7.2.2 Methodological changes

7.2.2.1 Glass production (2.A.3)

Following a recommendation of the 2022 NEC Review, process specific emissions from glass production are now reported (2020: + 0.004 kt $PM_{2.5}$).

7.2.2.2 Construction and demolition (2.A.5.b)

As a follow up to an issue raised at the 2022 NEC Review in depth QA showed that for PM emissions from road construction a wrong EF was used. Now emission factors from the 2019 EMEP Guidebooks are applied for all subcategories (2020: + 0.16 kt $PM_{2.5}$).

7.2.2.3 Solvent and other product use (2.D.3 except 2.D.3.b and 2.D.3.c)

During extensive quality checks several minor errors of the VOC directive data analysis used as basis for the bottom up approach for the years 2015 and 2019 were identified and subsequently corrected. As data from 2002 to 2015 is interpolated, this affected emissions from 2003 onwards (+ 0.01 kt NMVOC in 2020).

7.2.2.4 Roof covering with asphalt materials (2.D.3.c)

The emission factor for NMVOC emissions was updated considering data from another producer of asphalt roofing material (2020: + 0.002 kt NMVOC).

7.2.2.5 Fireworks (2.G.)

An emission factor derived from actual measurements has been applied. Furthermore acitvity data for 2020 was updated (2020: -0.02 kt $PM_{2.5}$).

7.2.2.6 Food and beverages industry (2.H.1)

Following a recommendation from the 2022 NEC Review, new sources (sugar and animal feed production) were considered (+ 0.59 kt NMVOC).

7.3 AGRICULTURE (3)

7.3.1 Update of activity data

7.3.1.1 Manure Management (3.B), Agricultural Soils (3.D)

Livestock data – poultry and deer

Updated livestock data for poultry (layers, broilers, turkeys, other poultry) and deer became available for the year 2020, based on the final results of the farm structure survey 2020 (STATISTIK AUSTRIA 2022[10]). For 2016, activity data of the farm structure survey 2016 was used (STATISTIK AUSTRIA 2018[11]). The numbers for the years 2017, 2018 and 2019 have been derived by interpolation.

Background data for feeding and nutrition of cattle

New values for the protein content of milk for the years 2019 and 2020 and for the fat content of milk for 2020 became available (AMA 2021[12]). In addition, for the years 1996-2004 and 2014-2020 the data on distribution of cattle breeds were updated, leading to minor changes. These improvements resulted in minor revisions of the values for gross energy intake, $N_{excretion}$ and $VS_{excretion}$ of dairy and suckling cows.

Biogas plants

Updated figures on biogas plants (E-CONTROL 2022[13]) resulted in slight revisions within source categories *3.B Manure Management*, *3.D.a.2.a Animal manure applied to soils* and *3.D.a.2.c Other organic fertilizers applied to soils*.

7.3.2 Methodological changes

7.3.2.1 Manure Management (3.B) – NH_3, NO_x, and NMVOC

In the current inventory, the continued reduced use of tied systems in cattle farming was taken into account for the first time. In previous inventories the 2017 values, derived from a national study (PÖLLINGER et al. 2018), were kept constant for 2018-2020. Taking into account the existing provisions of animal welfare, adjustments were necessary for the years after 2017. Trend extrapolation resulted in increased shares of loose housing systems and decreased

[10] Statistik Austria (2022): Final results of the farm structure survey 2020 https://www.statistik.at/fileadmin/publications/SB_1-17_AS2020.pdf

[11] STATISTIK AUSTRIA (2018): Agrarstrukturerhebung: Stichprobenerhebung 2016. Schnellbericht 1.17, Wien.

[12] AMA (2021): Rohmilchqualität | AMA - AgrarMarkt Austria

[13] E-CONTROL (2022): EC_EAG_Monitoringb_15.09_DRUCK.indd (e-control.at) accessed in November 2022

shares of tied systems. However, the overall shares of liquid and solid systems based on (PÖLLINGER et al. 2018) remained unchanged.

Another reason for revised estimates are the improved activity and nutrition data as already explained above.

Overall, NH_3 emissions from manure management have increased and NO_x and NMVOC emissions have slightly decreased compared to the previous submission (+0.6 kt NH_3, -0.005 kt NO_x and -0.09 kt NMVOC for 2020).

7.3.2.2 Manure Management (3.B) – PM

The revision of livestock numbers of poultry and deer based on the final results of the farm structure survey 2020 (STATISTIK AUSTRIA 2022[14]) resulted in slight recalculations of PM emissions (-0.00005 kt $PM_{2.5}$ for 2020).

7.3.2.3 Agricultural Soils (3.D) – NH_3, NO_x and NMVOC

Animal Manure Applied to Soils (3.D.a.2.a)

Updated activity and nutrition data as well as improvements in the area of animal husbandry (as described before) resulted in revisions of NH_3, NO_x and NMVOC emissions. Additionally, the correction of a linkage error resulted in revised numbers of ammonia and NMVOC emissions (-0.3 kt NH_3, -0.03 kt NO_x and -0.5 kt NMVOC for 2020).

Urine and dung deposited by Grazing Animals (3.D.a.3)

Livestock related updates as already described above, resulted in slightly revised emissions for the years 1996-2004 and 2014-2020 (-0.001 kt NH_3, -0.002 kt NO_x and +0.00002 kt NMVOC for 2020).

7.3.2.4 Agricultural Soils (3.D) – NMVOC

Cultivated crops (3.D.e)

Revisions of cropland and grassland areas led to slightly changed NMVOC emissions for the years 2014-2020 (+0.04 kt NMVOC for 2020).

7.3.2.5 Agricultural Soils (3.D) – PM

On-farm storage, handling and transport of agricultural products (3.D.c)

Revisions of cropland and grassland areas led to slightly changed PM emissions for the years 2014-2020 (+0.001 kt $PM_{2.5}$).

[14] Statistik Austria (2022): Final results of the farm structure survey 2020 https://www.statistik.at/fileadmin/publications/SB_1-17_AS2020.pdf

7.3.2.6 Field burning of agricultural residues (3.F) – NO_x, SO_2, NMVOC, NH_3, PM

Following a recommendation of the NEC Review 2022, emissions from the burning of residual wood from vinicultures on open fields (former reported under *3.F.5 Other*) have been reallocated to category *5.C.2.1.b Incineration and Open Burning of Waste – Other*. This reallocation results in lower emissions of NO_x, SO_2, NMVOC, NH_3 and PM for the entire time series.

7.4 WASTE (5)

7.4.1 Update of activity data

7.4.1.1 Solid waste disposal on land (5.A.1)

Minor revisions are reported for NMVOC and NH_3 emissions from category *5.A Solid Waste Disposal on Land* for the years 2016-2020 (< 0.00001 kt) due to slightly revised input (disposal) data as a result of more comprehensive QA/QC activities.

7.4.1.2 Biological treatment of waste – Composting (5.B.1)

A new method for estimating home composted waste amounts was developed in view of an upcoming reporting obligation regarding home-composted quantities to the European Commission (In the future, home composting will be included in the AT recycling rate for municipal waste). The new method developed for the Federal Waste Management Plan 2023[15] provides a more plausible estimate compared to the method previously applied (based on a per capita volume derived from one analysis provided for a city in Austria) and leads to lower emissions of NH_3 for 2001-2020 (2020: -0.3 kt)

7.4.1.3 Anaerobic digestion at biogas facilities (5.B.2)

Recalculations of NH_3 reported for 5*.B.2 anaerobic digestion at biogas facilities* (+ 0.002 kt in 2020) are due to update of activity and nutrition data (livestock data of poultry and deer, $N_{excretion}$ of cattle, biogas plants) as well as improvements in the area of animal husbandry. See also Chapter 7.3 on recalculations in the agriculture sector.

[15] https://www.bmk.gv.at/themen/klima_umwelt/abfall/aws/bundes_awp/bawp2023.html

7.4.1.4 Other waste (5.E)

In this category *5.E* recalculations for 2020 emissions were carried out for particulate matter (TSP, PM10, PM2.5: +0.00001 t) as well as Cd, Hg, Pb and dioxine (< 0.00001 t) as statistical information on accidental building fires became available.

7.4.2 Methodological changes/Re-allocation

7.4.2.1 Open burning of waste (5.C.2)

Following a recommendation of the NEC Review 2022, emissions from the burning of residual wood from vinicultures on open fields (formerly reported under *3.F.5 Other*) have been reallocated from *3.F.5 Other* to category *5.C.2.1.b Incineration and Open Burning of Waste – Other*. This reallocation results in higher emissions of NO_x, SO_2, NMVOC, NH_3 and PM in this category for the entire time series.

7.4.2.2 Industrial wastewater handling (5.D.2)

NMVOC emissions from on-site industrial wastewater handling are reported in this years' submission for the first time, resulting in higher emissions from category *5.D wastewater handling* over the whole time series (2020: +0.01 kt NMVOC).

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ANNEX 1: AUSTRIA´S EMISSIONS BASED ON FUEL SOLD (WITH 'FUEL EXPORTS')

Notation keys:

NE (not estimated) ..... for existing emissions by sources and removals by sinks of pollutants which have not been estimated.

IE (included elsewhere) ... for emissions by sources and removals by sinks of pollutants estimated but included elsewhere in the inventory instead of the expected source/sink category.

NO (not occurring) ..... for emissions by sources and removals by sinks of pollutants that do not occur for a particular gas or source/sink category.

NA (not applicable) ..... for activities in a given source/sink category that do not result in emissions or removals of a specific pollutant.

C (confidential)..... for emissions which could lead to the disclosure of confidential information if reported at the most disaggregated level. In this case, a minimum of aggregation is required to protect business information.

The complete tables in the NFR format are submitted separately in digital form only (Excel files).

Table A.I-1: SO_2 emissions [in kilotonnes] 1990–2021 based on fuel sold. (Source: Umweltbundesamt)

	NFR								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	71.69	69.69	2.00	1.93	0.00	0.07	NO	73.70	0.25
1991	69.06	67.76	1.30	1.61	0.00	0.06	NO	70.73	0.28
1992	52.79	50.79	2.00	1.36	0.00	0.04	NO	54.20	0.30
1993	51.66	49.56	2.10	1.11	0.00	0.04	NO	52.82	0.32
1994	46.16	44.88	1.28	1.12	0.00	0.05	NO	47.33	0.34
1995	46.18	44.65	1.53	1.07	0.00	0.05	NO	47.31	0.38
1996	42.90	41.70	1.20	0.99	0.00	0.05	NO	43.94	0.42
1997	39.36	39.29	0.07	0.96	0.00	0.06	NO	40.38	0.43
1998	34.65	34.61	0.04	0.87	0.00	0.06	NO	35.59	0.45
1999	32.84	32.79	0.04	0.81	0.00	0.06	NO	33.71	0.44
2000	30.68	30.63	0.04	0.78	0.00	0.06	NO	31.52	0.48
2001	31.61	31.56	0.05	0.71	0.00	0.06	NO	32.38	0.47
2002	30.51	30.47	0.04	0.71	0.00	0.06	NO	31.28	0.43
2003	30.28	30.23	0.05	0.71	0.00	0.06	NO	31.05	0.40
2004	25.78	25.74	0.04	0.72	0.01	0.06	NO	26.57	0.47
2005	25.11	25.07	0.04	0.72	0.00	0.06	NO	25.89	0.55
2006	25.88	25.83	0.05	0.73	0.00	0.05	NO	26.66	0.58
2007	22.55	22.49	0.05	0.75	0.00	0.04	NO	23.34	0.61
2008	19.46	19.41	0.04	0.78	0.00	0.03	NO	20.27	0.61
2009	14.03	13.97	0.06	0.70	0.00	0.02	NO	14.75	0.53
2010	15.27	15.22	0.05	0.70	0.00	0.01	NO	15.99	0.57
2011	14.47	14.43	0.05	0.68	0.00	0.01	NO	15.17	0.60
2012	14.12	14.08	0.05	0.65	0.00	0.01	NO	14.79	0.57
2013	13.75	13.71	0.04	0.58	0.00	0.01	NO	14.35	0.54
2014	13.95	13.91	0.04	0.56	0.00	0.01	NO	14.52	0.54
2015	13.53	13.49	0.04	0.55	0.00	0.01	NO	14.10	0.58
2016	12.70	12.67	0.02	0.56	0.00	0.01	NO	13.27	0.54
2017	12.21	12.17	0.04	0.57	0.00	0.01	NO	12.79	0.52
2018	11.01	10.98	0.02	0.56	0.00	0.01	NO	11.59	0.59
2019	10.56	10.54	0.02	0.59	0.00	0.01	NO	11.17	0.68
2020	9.81	9.79	0.02	0.58	0.00	0.02	NO	10.41	0.24
2021	10.27	10.24	0.03	0.59	NA	0.02	NO	10.87	0.27

Table A.I-2: NO_x emissions [in kilotonnes] 1990–2021 based on fuel sold. (Source: Umweltbundesamt)

	NFR								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	200.88	200.88	IE	4.27	13.66	0.12	NO	218.95	2.48
1991	210.82	210.82	IE	3.93	13.58	0.11	NO	228.44	2.80
1992	199.65	199.65	IE	4.02	13.16	0.08	NO	216.91	3.06
1993	193.87	193.87	IE	1.46	12.91	0.07	NO	208.31	3.27
1994	185.99	185.99	IE	1.38	12.71	0.07	NO	200.14	3.43
1995	185.63	185.63	IE	0.90	12.78	0.07	NO	199.37	3.85
1996	203.63	203.63	IE	0.87	12.60	0.07	NO	217.16	4.24
1997	189.84	189.84	IE	0.86	12.60	0.07	NO	203.37	4.43
1998	201.64	201.64	IE	0.83	12.61	0.07	NO	215.15	4.59
1999	193.82	193.82	IE	0.82	12.18	0.07	NO	206.89	4.52
2000	199.80	199.80	IE	0.83	11.93	0.07	NO	212.63	6.44
2001	210.61	210.61	IE	0.78	11.84	0.07	NO	223.29	6.32
2002	218.47	218.47	IE	0.79	11.79	0.07	NO	231.11	5.67
2003	229.99	229.99	IE	0.81	11.30	0.07	NO	242.17	5.21
2004	230.71	230.71	IE	0.69	10.74	0.07	NO	242.21	6.09
2005	236.29	236.29	IE	0.70	10.78	0.07	NO	247.85	6.99
2006	226.86	226.86	IE	0.58	10.81	0.06	NO	238.31	7.54
2007	220.13	220.13	IE	0.48	10.96	0.05	NO	231.62	7.99
2008	206.59	206.59	IE	0.56	11.48	0.05	NO	218.68	7.90
2009	193.50	193.50	IE	0.41	11.23	0.04	NO	205.18	6.86
2010	195.10	195.10	IE	0.55	10.34	0.03	NO	206.02	7.60
2011	186.67	186.67	IE	0.52	10.89	0.03	NO	198.10	7.98
2012	181.77	181.77	IE	0.55	10.98	0.03	NO	193.33	7.68
2013	182.42	182.42	IE	0.45	10.86	0.03	NO	193.76	7.46
2014	175.06	175.06	IE	0.46	11.15	0.03	NO	186.71	7.49
2015	171.94	171.94	IE	0.52	11.54	0.03	NO	184.03	8.18
2016	164.17	164.17	IE	0.52	11.79	0.03	NO	176.51	10.28
2017	155.17	155.17	IE	0.47	11.57	0.04	NO	167.24	10.06
2018	143.24	143.24	IE	0.41	11.28	0.04	NO	154.97	11.54
2019	134.42	134.42	IE	0.50	10.82	0.04	NO	145.77	13.47
2020	113.11	113.11	IE	0.48	10.84	0.04	NO	124.47	4.54
2021	111.13	111.13	IE	0.46	11.01	0.04	NO	122.64	5.35

Table A.I-3: NMVOC emissions [in kilotonnes] 1990–2021 based on fuel sold. (Source: Umweltbundesamt)

	NFR								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	163.98	148.39	15.59	118.97	50.94	0.17	NO	334.05	0.18
1991	165.95	150.72	15.23	112.45	49.98	0.17	NO	328.54	0.20
1992	152.11	136.81	15.30	105.71	47.48	0.16	NO	305.46	0.21
1993	140.32	125.55	14.77	99.03	46.94	0.16	NO	286.45	0.23
1994	125.12	113.89	11.23	92.42	46.50	0.15	NO	264.20	0.24
1995	116.90	107.30	9.60	85.75	45.80	0.15	NO	248.61	0.26
1996	110.36	101.78	8.58	84.21	44.61	0.14	NO	239.32	0.31
1997	98.30	90.22	8.07	82.86	43.73	0.14	NO	225.02	0.35
1998	91.52	84.97	6.55	81.58	43.59	0.14	NO	216.82	0.39
1999	83.87	78.08	5.79	78.83	42.81	0.13	NO	205.64	0.38
2000	77.25	71.45	5.80	62.61	41.43	0.13	NO	181.41	0.42
2001	73.90	69.95	3.95	61.02	40.76	0.12	NO	175.80	0.41
2002	70.27	66.12	4.14	60.61	39.88	0.12	NO	170.88	0.37
2003	67.99	63.92	4.07	59.21	39.40	0.12	NO	166.73	0.34
2004	64.20	60.51	3.69	50.02	39.09	0.12	NO	153.43	0.40
2005	61.48	58.01	3.46	57.19	38.39	0.12	NO	157.17	0.47
2006	58.05	54.57	3.48	62.99	38.05	0.11	NO	159.21	0.50
2007	55.14	52.03	3.11	61.99	38.00	0.11	NO	155.25	0.53
2008	52.75	49.86	2.89	59.48	37.76	0.11	NO	150.09	0.52
2009	49.86	47.14	2.72	49.31	38.11	0.10	NO	137.38	0.45
2010	51.22	48.65	2.57	48.71	37.88	0.10	NO	137.90	0.49
2011	46.99	44.45	2.54	48.79	37.19	0.09	NO	133.06	0.51
2012	46.53	44.00	2.53	47.36	36.82	0.08	NO	130.79	0.49
2013	45.70	43.26	2.44	42.36	36.85	0.08	NO	125.00	0.46
2014	40.76	38.19	2.57	40.60	36.92	0.08	NO	118.35	0.46
2015	40.88	38.40	2.48	35.64	36.81	0.07	NO	113.40	0.50
2016	40.19	37.76	2.43	35.11	36.82	0.07	NO	112.19	0.23
2017	39.59	37.14	2.45	36.23	36.83	0.07	NO	112.72	0.20
2018	36.29	33.95	2.34	36.10	36.28	0.06	NO	108.73	0.22
2019	36.09	33.69	2.41	36.45	35.74	0.06	NO	108.34	0.24
2020	34.37	32.34	2.03	40.70	35.41	0.06	NO	110.53	0.10
2021	36.99	34.97	2.02	38.42	35.36	0.06	NO	110.83	0.12

Table A.I-4: NH_3 emissions [in kilotonnes] 1990–2021 based on fuel sold. (Source: Umweltbundesamt)

	NFR								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	1.96	1.96	IE	0.34	66.60	0.37	NO	69.27	0.00
1991	2.43	2.43	IE	0.58	66.72	0.38	NO	70.11	0.00
1992	2.61	2.61	IE	0.44	64.17	0.43	NO	67.65	0.00
1993	2.89	2.89	IE	0.29	64.19	0.51	NO	67.88	0.00
1994	3.03	3.03	IE	0.24	63.80	0.60	NO	67.66	0.00
1995	3.22	3.22	IE	0.17	63.88	0.61	NO	67.88	0.00
1996	3.39	3.39	IE	0.16	62.75	0.63	NO	66.94	0.00
1997	3.46	3.46	IE	0.16	62.53	0.62	NO	66.78	0.00
1998	3.76	3.76	IE	0.17	62.68	0.65	NO	67.26	0.00
1999	3.79	3.79	IE	0.19	61.00	0.70	NO	65.68	0.00
2000	3.74	3.74	IE	0.17	59.50	0.74	NO	64.15	0.00
2001	3.91	3.91	IE	0.15	59.10	0.77	NO	63.92	0.00
2002	4.04	4.04	IE	0.13	57.96	0.79	NO	62.93	0.00
2003	4.15	4.15	IE	0.14	57.91	0.81	NO	63.02	0.00
2004	4.03	4.03	IE	0.12	57.51	1.00	NO	62.66	0.00
2005	4.01	4.00	0.00	0.13	57.47	1.09	NO	62.70	0.00
2006	3.93	3.92	0.01	0.14	57.83	1.12	NO	63.01	0.00
2007	3.83	3.83	0.01	0.14	59.24	1.16	NO	64.37	0.00
2008	3.58	3.57	0.00	0.14	58.86	1.15	NO	63.73	0.00
2009	3.38	3.37	0.00	0.15	60.47	1.15	NO	65.15	0.00
2010	3.43	3.42	0.00	0.15	60.40	1.17	NO	65.15	0.00
2011	3.13	3.12	0.00	0.16	60.11	1.17	NO	64.57	0.00
2012	3.00	3.00	0.00	0.15	60.49	1.18	NO	64.82	0.00
2013	2.82	2.82	0.00	0.16	60.68	1.11	NO	64.77	0.00
2014	2.60	2.60	0.00	0.15	61.57	1.16	NO	65.47	0.00
2015	2.65	2.65	0.00	0.14	62.30	1.17	NO	66.26	0.00
2016	2.56	2.56	0.00	0.15	63.24	1.22	NO	67.17	0.00
2017	2.59	2.59	0.00	0.17	63.92	1.21	NO	67.88	0.00
2018	2.55	2.55	0.00	0.14	62.96	1.19	NO	66.84	0.00
2019	2.57	2.57	0.00	0.16	61.96	1.21	NO	65.90	0.01
2020	2.31	2.31	0.00	0.16	61.82	1.24	NO	65.53	0.00
2021	2.47	2.47	0.00	0.14	61.96	1.27	NO	65.85	0.00

Table A.I-5: $PM_{2.5}$ emissions [in kilotonnes] 1990–2021 based on fuel sold. (Source: Umweltbundesamt)

	NFR								
	1	**1 A**	**1 B**	**2**	**3**	**5**	**6**		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	22.57	22.46	0.11	4.09	0.34	0.25	NO	27.26	0.27
1995	21.89	21.80	0.09	3.42	0.34	0.25	NO	25.90	0.41
2000	20.57	20.48	0.09	3.19	0.32	0.24	NO	24.33	0.52
2001	20.90	20.81	0.09	3.12	0.33	0.24	NO	24.59	0.51
2002	20.39	20.29	0.10	2.73	0.32	0.25	NO	23.69	0.46
2003	20.28	20.18	0.10	2.68	0.32	0.25	NO	23.53	0.43
2004	19.67	19.58	0.09	2.64	0.36	0.26	NO	22.94	0.51
2005	19.65	19.56	0.09	2.56	0.31	0.23	NO	22.75	0.59
2006	19.37	19.29	0.09	2.30	0.31	0.22	NO	22.20	0.63
2007	18.68	18.60	0.08	2.13	0.31	0.28	NO	21.39	0.66
2008	17.75	17.67	0.08	2.21	0.31	0.27	NO	20.53	0.66
2009	16.76	16.71	0.06	2.05	0.30	0.26	NO	19.38	0.57
2010	17.26	17.19	0.07	2.02	0.30	0.31	NO	19.89	0.62
2011	16.12	16.05	0.07	2.03	0.28	0.30	NO	18.74	0.65
2012	15.73	15.67	0.07	1.97	0.27	0.32	NO	18.28	0.62
2013	15.19	15.12	0.07	1.95	0.26	0.28	NO	17.68	0.59
2014	13.58	13.52	0.06	1.99	0.27	0.33	NO	16.17	0.59
2015	13.40	13.33	0.07	1.93	0.26	0.34	NO	15.93	0.63
2016	13.02	12.96	0.06	1.93	0.26	0.33	NO	15.55	0.70
2017	12.79	12.72	0.07	1.95	0.26	0.33	NO	15.33	0.67
2018	11.78	11.72	0.06	1.88	0.26	0.29	NO	14.21	0.76
2019	11.45	11.39	0.06	1.96	0.26	0.34	NO	14.01	0.88
2020	10.90	10.85	0.05	1.86	0.25	0.34	NO	13.35	0.31
2021	11.42	11.37	0.05	1.93	0.25	0.34	NO	13.94	0.37

ANNEX 2: AUSTRIA´S EMISSIONS BASED ON FUEL USED (WITHOUT 'FUEL EXPORTS')

Notation keys:

NE (not estimated) ..... for existing emissions by sources and removals by sinks of pollutants, which have not been estimated.

IE (included elsewhere) ... for emissions by sources and removals by sinks of pollutants estimated but included elsewhere in the inventory instead of the expected source/sink category.

NO (not occurring) ..... for emissions by sources and removals by sinks of pollutants that do not occur for a particular gas or source/sink category.

NA (not applicable) ..... for activities in a given source/sink category that do not result in emissions or removals of a specific pollutant.

C (confidential)..... for emissions, which could lead to the disclosure of confidential information if reported at the most disaggregated level. In this case, a minimum of aggregation is required to protect business information.

Table A.II-1: SO_2 emissions [in kilotonnes] 1990–2021 based on fuel used. (Source: Umweltbundesamt)

	NFR Sectors								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	70.91	68.91	2.00	1.93	0.00	0.07	NO	72.92	0.25
1991	68.02	66.72	1.30	1.61	0.00	0.06	NO	69.69	0.28
1992	51.77	49.77	2.00	1.36	0.00	0.04	NO	53.17	0.30
1993	50.51	48.41	2.10	1.11	0.00	0.04	NO	51.66	0.32
1994	45.13	43.85	1.28	1.12	0.00	0.05	NO	46.30	0.34
1995	45.24	43.71	1.53	1.07	0.00	0.05	NO	46.36	0.38
1996	42.15	40.95	1.20	0.99	0.00	0.05	NO	43.20	0.42
1997	38.93	38.87	0.07	0.96	0.00	0.06	NO	39.96	0.43
1998	34.00	33.96	0.04	0.87	0.00	0.06	NO	34.93	0.45
1999	32.37	32.33	0.04	0.81	0.00	0.06	NO	33.25	0.44
2000	30.15	30.11	0.04	0.78	0.00	0.06	NO	30.99	0.48
2001	30.97	30.93	0.05	0.71	0.00	0.06	NO	31.75	0.47
2002	29.82	29.78	0.04	0.71	0.00	0.06	NO	30.60	0.43
2003	29.54	29.49	0.05	0.71	0.00	0.06	NO	30.31	0.40
2004	25.72	25.68	0.04	0.72	0.01	0.06	NO	26.51	0.47
2005	25.05	25.01	0.04	0.72	0.00	0.06	NO	25.84	0.55
2006	25.84	25.79	0.05	0.73	0.00	0.05	NO	26.62	0.58
2007	22.51	22.46	0.05	0.75	0.00	0.04	NO	23.30	0.61
2008	19.42	19.38	0.04	0.78	0.00	0.03	NO	20.24	0.61
2009	13.99	13.94	0.06	0.70	0.00	0.02	NO	14.71	0.53
2010	15.23	15.19	0.05	0.70	0.00	0.01	NO	15.95	0.57
2011	14.44	14.40	0.05	0.68	0.00	0.01	NO	15.13	0.60
2012	14.09	14.05	0.05	0.65	0.00	0.01	NO	14.76	0.57
2013	13.71	13.67	0.04	0.58	0.00	0.01	NO	14.31	0.54
2014	13.91	13.87	0.04	0.56	0.00	0.01	NO	14.48	0.54
2015	13.50	13.46	0.04	0.55	0.00	0.01	NO	14.07	0.58
2016	12.66	12.64	0.02	0.56	0.00	0.01	NO	13.23	0.54
2017	12.17	12.14	0.04	0.57	0.00	0.01	NO	12.75	0.52
2018	10.97	10.94	0.02	0.56	0.00	0.01	NO	11.55	0.59
2019	10.52	10.50	0.02	0.59	0.00	0.01	NO	11.13	0.68
2020	9.78	9.76	0.02	0.58	0.00	0.02	NO	10.38	0.24
2021	10.24	10.21	0.03	0.59	NA	0.02	NO	10.84	0.27

Table A.II-2: NO_x emissions [in kilotonnes] 1990–2021 based on fuel used. (Source: Umweltbundesamt)

	NFR Sectors								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	184.00	184.00	IE	4.27	13.66	0.12	NO	202.07	2.48
1991	186.07	186.07	IE	3.93	13.58	0.11	NO	203.69	2.80
1992	178.36	178.36	IE	4.02	13.16	0.08	NO	195.62	3.06
1993	172.60	172.60	IE	1.46	12.91	0.07	NO	187.04	3.27
1994	168.73	168.73	IE	1.38	12.71	0.07	NO	182.89	3.43
1995	168.26	168.26	IE	0.90	12.78	0.07	NO	182.00	3.85
1996	168.85	168.85	IE	0.87	12.60	0.07	NO	182.38	4.24
1997	169.14	169.14	IE	0.86	12.60	0.07	NO	182.67	4.43
1998	167.47	167.47	IE	0.83	12.61	0.07	NO	180.98	4.59
1999	168.01	168.01	IE	0.82	12.18	0.07	NO	181.08	4.52
2000	167.98	167.98	IE	0.83	11.93	0.07	NO	180.82	6.44
2001	171.14	171.14	IE	0.78	11.84	0.07	NO	183.83	6.32
2002	170.68	170.68	IE	0.79	11.79	0.07	NO	183.32	5.67
2003	175.58	175.58	IE	0.81	11.30	0.07	NO	187.76	5.21
2004	176.52	176.52	IE	0.69	10.74	0.07	NO	188.02	6.09
2005	179.29	179.29	IE	0.70	10.78	0.07	NO	190.84	6.99
2006	180.65	180.65	IE	0.58	10.81	0.06	NO	192.10	7.54
2007	177.01	177.01	IE	0.48	10.96	0.05	NO	188.50	7.99
2008	169.91	169.91	IE	0.56	11.48	0.05	NO	182.00	7.90
2009	157.75	157.75	IE	0.41	11.23	0.04	NO	169.43	6.86
2010	158.95	158.95	IE	0.55	10.34	0.03	NO	169.88	7.60
2011	157.59	157.59	IE	0.52	10.89	0.03	NO	169.02	7.98
2012	153.75	153.75	IE	0.55	10.98	0.03	NO	165.31	7.68
2013	150.96	150.96	IE	0.45	10.86	0.03	NO	162.30	7.46
2014	147.61	147.61	IE	0.46	11.15	0.03	NO	159.26	7.49
2015	145.70	145.70	IE	0.52	11.54	0.03	NO	157.80	8.18
2016	141.63	141.63	IE	0.52	11.79	0.03	NO	153.98	10.28
2017	134.90	134.90	IE	0.47	11.57	0.04	NO	146.97	10.06
2018	124.54	124.54	IE	0.41	11.28	0.04	NO	136.27	11.54
2019	117.41	117.41	IE	0.50	10.82	0.04	NO	128.77	13.47
2020	104.25	104.25	IE	0.48	10.84	0.04	NO	115.60	4.54
2021	102.59	102.59	IE	0.46	11.01	0.04	NO	114.10	5.35

Table A.II-3: NMVOC emissions [in kilotonnes] 1990–2021 based on fuel used. (Source: Umweltbundesamt)

	NFR Sectors								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	159.49	143.89	15.59	118.97	50.94	0.17	NO	329.56	0.18
1991	155.56	140.33	15.23	112.45	49.98	0.17	NO	318.16	0.20
1992	146.15	130.85	15.30	105.71	47.48	0.16	NO	299.50	0.21
1993	136.28	121.52	14.77	99.03	46.94	0.16	NO	282.42	0.23
1994	123.13	111.90	11.23	92.42	46.50	0.15	NO	262.20	0.24
1995	115.46	105.86	9.60	85.75	45.80	0.15	NO	247.16	0.26
1996	110.12	101.54	8.58	84.21	44.61	0.14	NO	239.08	0.31
1997	99.10	91.03	8.07	82.86	43.73	0.14	NO	225.83	0.35
1998	90.10	83.55	6.55	81.58	43.59	0.14	NO	215.40	0.39
1999	83.96	78.17	5.79	78.83	42.81	0.13	NO	205.73	0.38
2000	76.96	71.16	5.80	62.61	41.43	0.13	NO	181.12	0.42
2001	72.42	68.47	3.95	61.02	40.76	0.12	NO	174.32	0.41
2002	66.81	62.66	4.14	60.61	39.88	0.12	NO	167.42	0.37
2003	63.54	59.46	4.07	59.21	39.40	0.12	NO	162.27	0.34
2004	59.76	56.07	3.69	50.02	39.09	0.12	NO	148.99	0.40
2005	56.98	53.52	3.46	57.19	38.39	0.12	NO	152.68	0.47
2006	54.68	51.20	3.48	62.99	38.05	0.11	NO	155.83	0.50
2007	52.05	48.94	3.11	61.99	38.00	0.11	NO	152.16	0.53
2008	50.31	47.42	2.89	59.48	37.76	0.11	NO	147.65	0.52
2009	47.61	44.89	2.72	49.31	38.11	0.10	NO	135.13	0.45
2010	49.23	46.66	2.57	48.71	37.88	0.10	NO	135.91	0.49
2011	45.46	42.92	2.54	48.79	37.19	0.09	NO	131.53	0.51
2012	45.21	42.67	2.53	47.36	36.82	0.08	NO	129.47	0.49
2013	44.49	42.05	2.44	42.36	36.85	0.08	NO	123.79	0.46
2014	39.76	37.19	2.57	40.60	36.92	0.08	NO	117.35	0.46
2015	39.91	37.43	2.48	35.64	36.81	0.07	NO	112.44	0.50
2016	39.32	36.88	2.43	35.11	36.82	0.07	NO	111.32	0.23
2017	38.81	36.36	2.45	36.23	36.83	0.07	NO	111.94	0.20
2018	35.54	33.20	2.34	36.10	36.28	0.06	NO	107.98	0.22
2019	35.42	33.01	2.41	36.45	35.74	0.06	NO	107.67	0.24
2020	34.01	31.98	2.03	40.70	35.41	0.06	NO	110.18	0.10
2021	36.60	34.59	2.02	38.42	35.36	0.06	NO	110.45	0.12

Table A.II-4: NH_3 emissions [in kilotonnes] 1990–2021 based on fuel used. (Source: Umweltbundesamt)

	NFR Sectors								
	1	1 A	1 B	2	3	5	6		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	1.91	1.91	IE	0.34	66.60	0.37	NO	69.22	0.00
1991	2.26	2.26	IE	0.58	66.72	0.38	NO	69.94	0.00
1992	2.48	2.48	IE	0.44	64.17	0.43	NO	67.53	0.00
1993	2.79	2.79	IE	0.29	64.19	0.51	NO	67.77	0.00
1994	2.98	2.98	IE	0.24	63.80	0.60	NO	67.61	0.00
1995	3.18	3.18	IE	0.17	63.88	0.61	NO	67.84	0.00
1996	3.48	3.48	IE	0.16	62.75	0.63	NO	67.03	0.00
1997	3.60	3.60	IE	0.16	62.53	0.62	NO	66.92	0.00
1998	3.75	3.75	IE	0.17	62.68	0.65	NO	67.25	0.00
1999	3.93	3.93	IE	0.19	61.00	0.70	NO	65.81	0.00
2000	3.88	3.88	IE	0.17	59.50	0.74	NO	64.28	0.00
2001	3.90	3.90	IE	0.15	59.10	0.77	NO	63.91	0.00
2002	3.70	3.70	IE	0.13	57.96	0.79	NO	62.58	0.00
2003	3.61	3.61	IE	0.14	57.91	0.81	NO	62.48	0.00
2004	3.45	3.45	IE	0.12	57.51	1.00	NO	62.08	0.00
2005	3.38	3.37	0.00	0.13	57.47	1.09	NO	62.07	0.00
2006	3.34	3.33	0.01	0.14	57.83	1.12	NO	62.42	0.00
2007	3.24	3.23	0.01	0.14	59.24	1.16	NO	63.77	0.00
2008	3.07	3.07	0.00	0.14	58.86	1.15	NO	63.22	0.00
2009	2.87	2.87	0.00	0.15	60.47	1.15	NO	64.64	0.00
2010	2.94	2.94	0.00	0.15	60.40	1.17	NO	64.66	0.00
2011	2.73	2.72	0.00	0.16	60.11	1.17	NO	64.17	0.00
2012	2.64	2.64	0.00	0.15	60.49	1.18	NO	64.46	0.00
2013	2.50	2.50	0.00	0.16	60.68	1.11	NO	64.45	0.00
2014	2.32	2.32	0.00	0.15	61.57	1.16	NO	65.20	0.00
2015	2.36	2.36	0.00	0.14	62.30	1.17	NO	65.97	0.00
2016	2.27	2.27	0.00	0.15	63.24	1.22	NO	66.88	0.00
2017	2.32	2.32	0.00	0.17	63.92	1.21	NO	67.61	0.00
2018	2.25	2.25	0.00	0.14	62.96	1.19	NO	66.54	0.00
2019	2.27	2.27	0.00	0.16	61.96	1.21	NO	65.60	0.01
2020	2.16	2.16	0.00	0.16	61.82	1.24	NO	65.38	0.00
2021	2.30	2.30	0.00	0.14	61.96	1.27	NO	65.67	0.00

Table A.II-5: $PM_{2.5}$ emissions [in kilotonnes] 1990–2021 based on fuel used. (Source: Umweltbundesamt)

	NFR Sectors								
	1	**1 A**	**1 B**	**2**	**3**	**5**	**6**		
	ENERGY	FUEL COMBUSTION ACTIVITIES	FUGITIVE EMISSIONS FROM FUELS	INDUSTRIAL PROCESSES	AGRICULTURE	WASTE	OTHER	NATIONAL TOTAL	International Bunkers
1990	22.02	21.91	0.11	4.09	0.34	0.25	NO	26.71	0.27
1995	21.19	21.11	0.09	3.42	0.34	0.25	NO	25.21	0.41
2000	19.80	19.71	0.09	3.19	0.32	0.24	NO	23.56	0.52
2001	19.93	19.84	0.09	3.12	0.33	0.24	NO	23.62	0.51
2002	19.10	19.01	0.10	2.73	0.32	0.25	NO	22.41	0.46
2003	18.77	18.66	0.10	2.68	0.32	0.25	NO	22.02	0.43
2004	18.15	18.06	0.09	2.64	0.36	0.26	NO	21.42	0.51
2005	18.06	17.97	0.09	2.56	0.31	0.23	NO	21.16	0.59
2006	18.05	17.97	0.09	2.30	0.31	0.22	NO	20.88	0.63
2007	17.45	17.37	0.08	2.13	0.31	0.28	NO	20.17	0.66
2008	16.77	16.69	0.08	2.21	0.31	0.27	NO	19.55	0.66
2009	15.86	15.80	0.06	2.05	0.30	0.26	NO	18.48	0.57
2010	16.39	16.32	0.07	2.02	0.30	0.31	NO	19.02	0.62
2011	15.45	15.38	0.07	2.03	0.28	0.30	NO	18.07	0.65
2012	15.15	15.08	0.07	1.97	0.27	0.32	NO	17.70	0.62
2013	14.61	14.54	0.07	1.95	0.26	0.28	NO	17.10	0.59
2014	13.10	13.04	0.06	1.99	0.27	0.33	NO	15.69	0.59
2015	12.96	12.89	0.07	1.93	0.26	0.34	NO	15.50	0.63
2016	12.65	12.59	0.06	1.93	0.26	0.33	NO	15.18	0.70
2017	12.47	12.40	0.07	1.95	0.26	0.33	NO	15.01	0.67
2018	11.50	11.44	0.06	1.88	0.26	0.29	NO	13.93	0.76
2019	11.21	11.16	0.06	1.96	0.26	0.34	NO	13.77	0.88
2020	10.78	10.73	0.05	1.86	0.25	0.34	NO	13.23	0.31
2021	11.31	11.26	0.05	1.93	0.25	0.34	NO	13.83	0.37

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Austria's Annual Air Emission Inventory 1990–2021 provides an overview of national emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3), non-methane volatile organic compounds (NMVOC) and particulate matter ($PM_{2.5}$) from 1990 to 2021. Emission trends and recalculations of these air pollutants, regulated in the European NEC Directive, are described.

The results show that between 2020 and 2021 only NO_x emissions decreased by 1.8 kt (1.5 %). This was due to the fleet renewal with low-emission vehicles in passenger car and truck traffic, which reduced the emission level despite increased mileage. The emissions of the other NEC pollutants increased from 2020 to 2021: SO_2 by 4.4 %, NH_3 by 0.5 %, NMVOC by 0.3 % and $PM_{2.5}$ by 4.5 %. The national emission reduction commitments were met, except for NH_3, which exceeded the target by 6 %.

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