ENVIRONMENT AGENCY AUSTRIA umweltbundesamt

Austria's Annual Air Emission Inventory 1990—2018

Emissions of SO_2, NO_x, NMVOC, NH_3 and $PM_{2,5}$

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INHALTSVERZEICHNIS/TABLE OF CONTENTS

1 EINLEITUNG

Dieser Bericht beinhaltet eine Zusammenfassung der jährlichen SO_2, NO_x, NH_3, NMVOC und $PM_{2.5}$-Emissionsdaten. Es werden der aktuelle Datenstand, der am 15. Februar 2020 an die Europäische Kommission übermittelt wurde, die wichtigsten Trends sowie die wesentlichen methodischen Änderungen gegenüber dem Vorjahr dargestellt.

- Annex 1 beinhaltet die Emissionstrends der Schadstoffe SO_2, NO_x, NH_3, NMVOC und $PM_{2.5}$ abzüglich der Emissionsmengen aus preisbedingtem Kraftstoffexport in Fahrzeugen (Emissionen berichtet auf Basis „fuel used“).
- Annex 2 enthält die Gesamtemissionen dieser Schadstoffe basierend auf dem inländischen Kraftstoffabsatz (Emissionen berichtet auf Basis „fuel sold“).

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

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.

Die folgende Tabelle gibt den Stand der Daten und das Berichtsformat der vorliegenden Publikation an:

Tabelle 1: Datengrundlage des vorliegenden Berichts.

Inventur	Datenstand	Berichtsformat
OLI 2019	13. Februar 2020	NFR-Format der UNECE

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.

2 EMISSIONSTRENDS

Die offiziellen Inventurdaten für den Vergleich mit den nationalen NEC-Emissionshöchstmengen ab 2010 werden für Österreich nicht auf Basis des verkauften Kraftstoffs sondern auf Basis des verbrauchten Kraftstoffs ermittelt (EU-Emissionshöchstmengenrichtlinie, NEC-Richtlinie (EU) 2016/2284; Anhang IV). Die Emissionen durch Kraftstoffexport in Fahrzeugtanks sind daher in der offiziellen NEC-Emissionsmenge Österreichs nicht enthalten.

2.1 Emissionen ohne Kraftstoffexport

Tabelle 2 und Abbildung 1 zeigen die österreichischen Inventurdaten der Schadstoffe SO_2, NO_x, NH_3, NMVOC und $PM_{2.5}$ ohne Berücksichtigung der Emissionen aus dem Kraftstoffexport (Emissionen berechnet auf Basis “fuel used“).

Tabelle 2: Gesamtemissionen Österreichs ohne Kraftstoffexport in Fahrzeugtanks, 1990–2018. (Quelle: Umweltbundesamt)

	Emissionen ohne Kraftstoffexport [Kilotonnen]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$**
1990	72,90	199,91	329,26	61,68	26,61
1995	45,85	180,09	244,98	63,06	24,99
2000	31,04	178,87	179,43	60,71	23,34
2001	31,81	181,89	172,54	60,64	23,40
2002	30,70	181,62	165,43	59,63	22,27
2003	30,43	186,13	161,23	59,52	21,86
2004	26,54	186,03	148,32	59,35	21,30
2005	25,90	189,41	152,63	59,24	21,09
2006	26,75	190,95	155,93	59,74	20,87
2007	23,41	187,28	151,77	61,05	20,16
2008	20,30	180,60	146,55	60,80	19,50
2009	14,76	168,03	133,31	62,22	18,40
2010	16,00	168,18	133,44	62,19	19,02
2011	15,20	166,85	128,40	61,72	18,08
2012	14,83	162,72	126,10	62,04	17,69
2013	14,40	159,61	120,34	62,16	17,12
2014	14,51	155,79	113,64	62,94	15,65
2015	13,95	153,92	110,48	63,72	15,53
2016	13,28	150,00	108,85	64,52	15,19
2017	12,81	143,42	109,94	65,39	14,98
2018	11,73	135,74	106,55	64,38	14,01

Von 2017 auf 2018 sind für die Emissionen von SO_2, NO_x, NMVOC, NH_3 und $PM_{2.5}$ Rückgänge zu verzeichnen.

In der EU-Emissionshöchstmengenrichtlinie (engl.: National Emission Ceilings, „NEC"-Directive), national umgesetzt im Emissionsgesetz-Luft 2018 (EG-L 2018, BGBl. I Nr. 75/2018), sind für die Jahre ab 2010 Emissionshöchstmengen für die Luftschadstoffe Schwefeldioxid (SO_2), Stickstoffoxide (NO_x), flüchtige Kohlenwasserstoffe ohne Methan (NMVOC) und Ammoniak (NH_3) festgelegt. Für den Vergleich mit den zulässigen nationalen Emissionshöchstmengen ab 2010 werden für Österreich die Emissionen ohne Kraftstoffexport herangezogen[1].

Die für Österreich für den Zeitraum ab 2010 festgelegten NEC-Emissionshöchstmengen sind:

- 39 kt für Schwefeldioxid (SO_2),
- 103 kt für Stickstoffoxide (NO_x),
- 159 kt für die flüchtigen Kohlenwasserstoffe ohne Methan (NMVOC) und
- 66 kt für Ammoniak (NH_3).

Für die NO_x-Zielerreichung nimmt Österreich die Flexibilitätsregelungen gemäß NEC-Richtlinie 2016/2284, Artikel 5, in Anspruch (siehe Kapitel 2.2).

Minderungsziele für die Feinstaubfraktion $PM_{2.5}$ sind in der NEC-Richtlinie erst für den Zeitraum ab 2020 festgeschrieben.

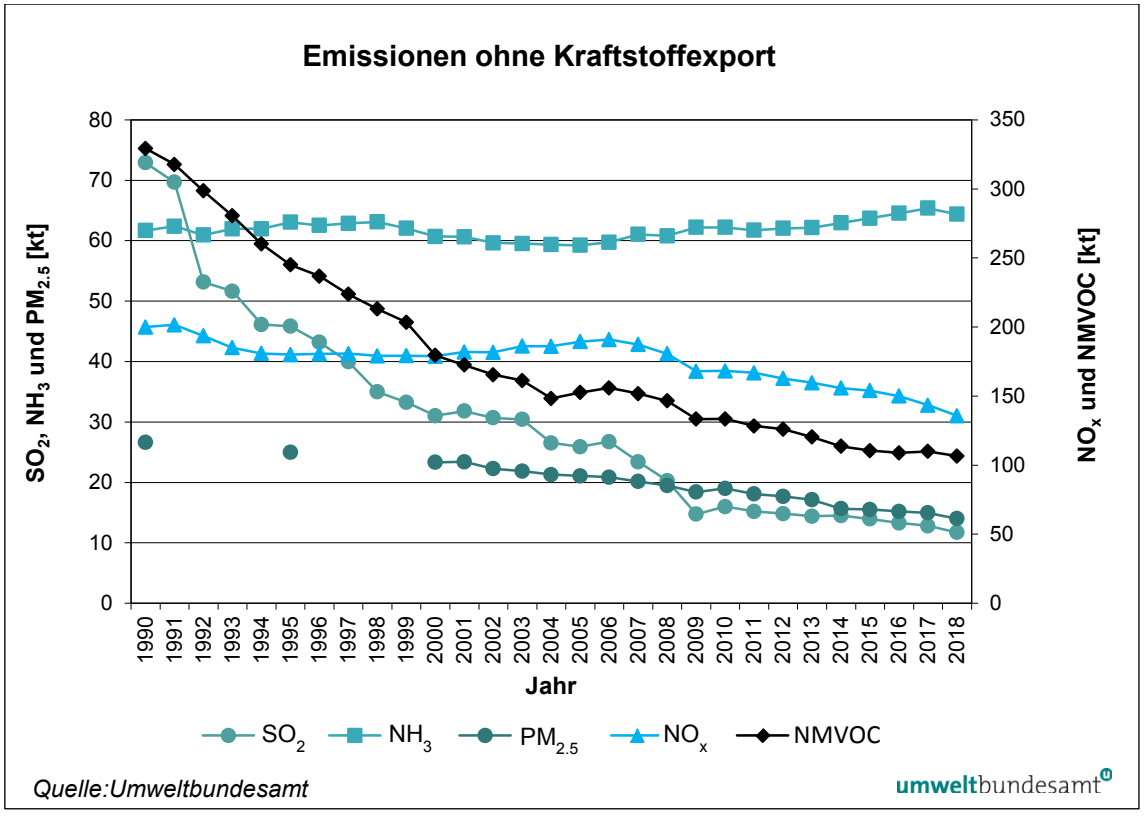

Abbildung 1: SO_2, NO_x, NMVOC, NH_3 und $PM_{2.5}$-Emissionen ohne Kraftstoffexport.

[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.

2.2 Flexibilitätsregelungen und Zielerreichung

Gemäß revidierter NEC-Richtlinie 2016/2284 können die EU-Mitgliedstaaten unter bestimmten, detailliert zu begründenden Umständen bei einer Überschreitung der NEC-Emissionshöchstmengen Flexibilitätsregelungen für die Zielerreichung nutzen. Für die Schadstoffgruppe NO_x wird diese Möglichkeit von Österreich im Rahmen der Berichterstattung 2020 in Anspruch genommen.

2.2.1 Einreichung von Inventur-Anpassungsvorschlägen

Österreich hat in den Jahren 2017[2] und 2018[3] Vorschläge zur Anpassung spezifischer Inventurdaten für die NO_x- und NH_3-Zielerreichung bei der Europäischen Kommission eingereicht. Ausschlaggebend dafür sind die mangelnde Wirksamkeit der auf EU-Ebene erlassenen Kfz-Abgasvorschriften (NO_x) sowie der Umstand, dass bestimmte Emissionsquellen im Landwirtschaftssektor bei der Festlegung der Zielwerte nicht berücksichtigt wurden (NO_x, NH_3).

Die Vorschläge wurden von der Europäischen Kommission bewilligt[4,5,6]. Damit ist es legitim, die Anpassungswerte für den NEC-Zielvergleich von der nationalen Emissionsmenge abzuziehen.

Am 15. Februar 2019 wurden die neue Inventur-Zeitreihe 1990–2017 sowie eine Aktualisierung der in den Jahren 2017 und 2018 bewilligten Anpassungswerte von Österreich an die Europäische Kommission übermittelt.

Durch die Revision der Ammoniakemissionen in der vorliegenden Inventur (siehe Kapitel 6.4) liegen die nationalen Emissionsmengen in allen Jahren von 2010 bis 2018 unter der in der NEC-Richtlinie festgesetzten Höchstmenge von 66 kt NH_3. Für Ammoniak wurden daher in der heurigen Berichterstattung unter der NEC-RL 2016/2284 keine Anpassungsvorschläge eingereicht.

In Tabelle 3 sind die bewilligten Anpassungswerte (aktualisiert für die Jahre 2010–2017), die angepassten nationalen Emissionswerte sowie die nationalen Emissionshöchstwerte für NO_x zusammengefasst dargestellt.

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[2] UMWELTBUNDESAMT (2017): Anderl, M., Kriech, M.: Austria's Informative Adjustment Report 2017. Austria's applications for inventory adjustment pursuant to Article 5 (1) of the NEC Directive 2016/2284 (Addendum to Austria's IIR 2017). Reports, Bd. REP-0613. Umweltbundesamt, Wien.

[3] UMWELTBUNDESAMT (2018): Anderl, M., Haider, S., Kriech, M., Stranner, G.: Austria´s Inventory Adjustment Report 2018. Austria's applications for inventory adjustment pursuant to Article 5 (1) of the NEC Directive 2016/2284 (Addendum to Austria´s IIR 2018). Reports, Bd. REP-0648. Umweltbundesamt, Wien.

[4] EEA – European Environment Agency(2017): Final Review Report – 2017 Comprehensive Technical Review of National Emission Inventories pursuant to the Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (Directive (EU) 2016/2284) – Austria. Reference: No 07.0201/2016/741511/SER/ENV.C.3

[5] EEA – European Environment Agency (2018): Final Review Report 2018 – Second Phase of review of national air pollution emission inventory data pursuant to the Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (Directive (EU) 2016/2284 or 'NECD') – Austria. Reference: 070203/2017/765105/SER/ENV.C.3

[6] EEA – European Environment Agency (2019): Final Review Report 2019 – Third Phase of review of national air pollution emission inventory data pursuant to the Directive on the Reduction of National Emissions of Certain Atmospheric Pollutants (Directive (EU) 2016/2284 or 'NECD') – Austria. Reference: Service Request No 4 under Framework Contract No ENV.C.3/FRA/2017/0012.

Tabelle 3: Bewilligte Anpassungswerte, angepasste Inventurdaten und Emissionshöchstmengen 2010–2018. (Quelle: Umweltbundesamt)

	Bewilligte Anpassungswerte („approved adjustments“)	Angepasste Inventurdaten (2020)	Zulässige Emissionshöchstmengen (ab 2010)
	NO_x	**NO_x**	**NO_x**
2010	– 52,01 kt	116,17 kt	103 kt
2011	– 55,05 kt	111,79 kt	103 kt
2012	– 56,51 kt	106,21 kt	103 kt
2013	– 57,96 kt	101,65 kt	103 kt
2014	– 59,41 kt	96,38 kt	103 kt
2015	– 59,30 kt	94,62 kt	103 kt
2016	– 56,99 kt	93,01 kt	103 kt
2017	– 52,35 kt	91,07 kt	103 kt
2018	– 48,34 kt	87,40 kt	103 kt

Auf Basis der NEC-Emissionsberichterstattung 2020 (Zeitreihe 1990–2018) stellt sich der Zielvergleich wie folgt dar:

- Die festgesetzte Emissionshöchstmenge für NO_x (103 kt ab 2010) wurde in den Jahren 2010–2012 überschritten.
- Unter Berücksichtigung der bewilligten Anpassungen wird die festgesetzte Emissionshöchstmenge für NO_x seit 2013 unterschritten.
- Für die Luftschadstoffe SO_2, NMVOC und NH_3 werden die ab 2010 festgesetzten Emissionshöchstmengen (39 kt für SO_2, 159 kt für NMVOC und 66 kt für NH_3) unterschritten.

2.3 Emissionen inklusive Kraftstoffexport

Im Folgenden sind die Trends der SO_2, NO_x, NH_3, NMVOC und $PM_{2.5}$-Emissionen Österreichs auf Basis der in Österreich verkauften Treibstoffmengen („fuel sold“) dargestellt. Dabei ist zu beachten, dass in Österreich ein beachtlicher Teil der verkauften Treibstoffmenge zwar im Inland getankt, jedoch im Ausland verfahren wurde (Kraftstoffexport in Fahrzeugtanks, oft auch als „Tanktourismus“ bezeichnet).

Tabelle 4: Gesamtemissionen Österreichs inklusive Kraftstoffexport, 1990–2018. (Quelle: Umweltbundesamt)

	Gesamtemissionen Österreichs inklusive Kraftstoffexport [Kilotonnen]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$**
1990	73,70	217,22	334,02	61,73	27,17
1995	46,81	197,88	246,57	63,11	25,69
2000	31,58	211,10	179,79	60,58	24,12
2001	32,46	221,81	174,09	60,66	24,38
2002	31,39	229,69	168,94	59,99	23,56
2003	31,17	240,90	165,74	60,07	23,39
2004	26,60	240,59	152,83	59,94	22,83
2005	25,95	246,14	157,11	59,87	22,67
2006	26,79	236,09	159,25	60,32	22,17

	Gesamtemissionen Österreichs inklusive Kraftstoffexport [Kilotonnen]				
	SO_2	NO_x	NMVOC	NH_3	$PM_{2.5}$
2007	23,44	228,56	154,80	61,64	21,35
2008	20,33	215,12	148,94	61,31	20,44
2009	14,80	201,09	135,51	62,73	19,27
2010	16,04	202,15	135,41	62,69	19,87
2011	15,23	194,02	129,93	62,13	18,73
2012	14,86	188,87	127,42	62,41	18,27
2013	14,44	188,07	121,56	62,48	17,69
2014	14,54	179,43	114,63	63,23	16,11
2015	13,98	176,36	111,44	64,01	15,94
2016	13,32	170,30	109,73	64,81	15,56
2017	12,84	161,95	110,73	65,67	15,30
2018	11,77	150,86	107,22	64,63	14,26

2.4 Kraftstoffexport

Im Jahr 2004 wurde vom Bundesministerium für Nachhaltigkeit und Tourismus (damals Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft) eine Studie in Auftrag gegeben[7], in welcher die Auswirkungen des Kraftstoffexports in Fahrzeugtanks auf den Treibstoffverbrauch und die Entwicklung der verkehrsbedingten Emissionen in Österreich abgeschätzt wurden. Eine Folgestudie aus dem Jahr 2008/2009[8] bestätigte das Ausmaß des Kraftstoffexports. 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 Kfz".

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

Nachstehende Tabelle gibt Auskunft über die Emissionsmengen, die auf den Kraftstoffexport in Fahrzeugtanks zurückzuführen sind. Im Jahr 2018 sind 15,1 kt, das sind rund 10 % der NO_x-Gesamtemissionen Österreichs, auf diesen Effekt zurückzuführen. Besonders ab Ende der 90er 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.

[7] HAUSBERGER, S. & MOLITOR, R. (2004): Abschätzung der Auswirkungen des Tanktourismus auf den Treibstoffverbrauch und die Entwicklung der CO_2-Emissionen in Österreich. TU Graz im Auftrag des Lebensministeriums, nicht veröffentlicht. Graz, 2004.

[8] HAUSBERGER, S. & MOLITOR, R. (2009): Abschätzung der Auswirkungen des Tanktourismus auf den Treibstoffverbrauch und die Entwicklung der CO_2-Emissionen in Österreich. TU Graz im Auftrag des BMLFUW und BMVIT, nicht veröffentlicht. Graz, 2009.

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

	Emissionen in tausend Tonnen [Kilotonnen]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$**
1990	0,80	17,31	4,75	0,05	0,56
1995	0,96	17,79	1,60	0,05	0,71
2000	0,53	32,23	0,36	– 0,13	0,78
2001	0,64	39,92	1,55	0,02	0,99
2002	0,69	48,07	3,52	0,35	1,30
2003	0,74	54,77	4,51	0,55	1,52
2004	0,06	54,56	4,51	0,60	1,53
2005	0,05	56,74	4,49	0,63	1,58
2006	0,04	45,13	3,33	0,59	1,30
2007	0,04	41,28	3,04	0,60	1,19
2008	0,03	34,52	2,38	0,51	0,94
2009	0,03	33,06	2,21	0,51	0,87
2010	0,04	33,97	1,97	0,49	0,85
2011	0,03	27,17	1,52	0,41	0,65
2012	0,03	26,15	1,33	0,37	0,58
2013	0,04	28,45	1,22	0,33	0,57
2014	0,03	23,64	0,99	0,28	0,45
2015	0,03	22,44	0,96	0,29	0,42
2016	0,04	20,30	0,88	0,29	0,37
2017	0,04	18,53	0,79	0,28	0,32
2018	0,04	15,12	0,67	0,26	0,25

2.5 Beschreibung der Trends

2.5.1 SO_2-Emissionen

2018 betrugen die SO_2-Emissionen 11,7 kt (ohne Kraftstoffexport). Seit 1990 (72,9 kt) nahmen die Emissionen stetig ab.

Von 1990 bis 2018 konnten die SO_2-Emissionen (ohne Kraftstoffexport) um 83,9 % reduziert werden. Das ist vorwiegend auf die Absenkung des Schwefelanteils in Mineralölprodukten und Treibstoffen (gemäß Kraftstoffverordnung), den Einbau von Entschwefelungsanlagen in Kraftwerken (gemäß Luftreinhaltegesetz für Kesselanlagen) sowie die verstärkte Nutzung schwefelärmerer Brennstoffe, wie z. B. Erdgas, zurückzuführen. Die Wirtschaftskrise verursachte einen Einbruch der SO_2-Emissionen im Jahr 2009, der allerdings bereits 2010 durch die Erholung der Wirtschaft ausgeglichen wurde. Die starke Reduktion der Emissionen von 1991–1992 ist auf den reduzierten Kohleeinsatz in Kraftwerken (1.A.1.a) und die Einführung von Minderungsmaßnahmen bei Ölkraftwerken (1.A.1) sowie der Eisen- und Stahl (1.A.2.a) und Papierindustrie (1.A.2.d) zurückzuführen.

Von 2017 auf 2018 sind die SO_2-Emissionen (ohne Kraftstoffexport) um 1,1 kt (– 8,4 %) weiter gesunken; dies hauptsächlich aufgrund von wartungsbedingten Produktionsreduktionen der SO_2-Emissionen in der Eisen- und Stahlindustrie (1.A.2.a, – 0,62 kt).

Die SO_2-Emissionen inklusive Kraftstoffexport beliefen sich im Jahr 1990 auf 73,7 kt. Bis zum Jahr 2018 nahmen sie um 84,0 % auf 11,8 kt ab. Zwischen 2017 und 2018 sanken die Emissionen um 8,4 %.

2.5.2 NO_X-Emissionen

Für das Jahr 2018 wurde ein Ausstoß von rund 135,7 kt NO_x berechnet (ohne Kraftstoffexport). Im Jahr 1990 betrugen die NO_x-Emissionen ohne Kraftstoffexport 199,9 kt.

Seit 1990 nahmen die NO_x-Emissionen (ohne Kraftstoffexport) um 32,1 % ab. Von 1991 bis 1993 gab es eine auffällige Reduktion der NO_x-Emissionen, die auf die Sektoren 1.A.3.b (Passenger cars) sowie Minderungsmaßnahmen bei großen Kohle- und Ölkraftwerken (1.A.1.a) und der Chemischen Industrie (2.B.10.a) zurückzuführen ist. Die Wirtschaftskrise war hauptverantwortlich für die Reduktion der NO_x-Emissionen von 2008 auf 2009.

Von 2017 auf 2018 setzte sich der rückläufige Trend der NO_x-Emissionen (ohne Kraftstoffexport) mit einer Reduktion um 7,7 kt (– 5,4 %) fort. Hierfür verantwortlich sind vor allem die Rückgänge im Straßenverkehr, insbesondere im Bereich der Personenkraftwagen (1.A.3.b.1) (– 2.1kt) und der schweren Kraftfahrzeuge (1.A.3.b.3) (– 1.6kt). 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 2018 auf den Straßenverkehr mit 48,3 % (exklusive Kraftstoffexport) entfiel.

Die NO_x-Emissionen inklusive Kraftstoffexport sind im Zeitraum 1990 bis 2018 um 30,5 % von 217,2 kt auf rund 150,9 kt gesunken. Die NO_x-Emissionen inklusive Kraftstoffexport haben in den Jahren 2003 bis 2005 einen Höchstwert erreicht und gehen seither kontinuierlich zurück, was hauptsächlich auf geringere Emissionen des Schwerverkehrs zurückzuführen ist. Vor allem die Fortschritte bei der Abgasnachbehandlung schwerer Nutzfahrzeuge (Lkw und Busse) zeigten hier Wirkung. Verglichen mit 2017 beträgt der Rückgang im Jahr 2018 6,8 %. Der größte Anteil an den NO_x-Gesamtemissionen im Jahr 2018 fiel auf den Straßenverkehr mit 53,5 %.

2.5.3 NMVOC Emissionen

Die NMVOC-Emissionen ohne Kraftstoffexport betrugen im Jahr 2018 106,6 kt und im Jahr 1990 329,3 kt. Das entspricht einer Reduktion um 67,6 %. Von 2017 auf 2018 sind sie um 3,4 kt (– 3,1 %) gesunken.

Seit 1990 konnten die größten Reduktionen im Verkehrssektor erzielt werden, im Wesentlichen durch den verstärkten Einsatz von Katalysatoren und Diesel-Kfz. Aktuell nimmt der Verkehrssektor nur mehr einen geringen Anteil von 5 % an den gesamten NMVOC Emissionen ein. Im Lösemittelsektor konnten die Reduktionen aufgrund diverser gesetzlicher Regelungen (Lösungsmittelverordnung, HKW-Anlagen-Verordnung sowie VOC-Anlagen-Verordnung) erzielt werden. 2018 verursachte dieser Sektor rund 28 % der NMVOC-Emissionen. Gegenüber dem Vorjahr sanken die Emissionen leicht um 1 %. Den größten Anteil an den NMVOC-Emissionen hatte 2018 der Sektor Landwirtschaft mit 34 %. Hier sanken die Emissionen im Vergleich zu 2017 um 1 %. Der Hausbrand nimmt einen Anteil von 21 % ein und verzeichnete vor allem aufgrund der milden Witterung einen Rückgang von 8 % im Vergleich zu 2017. Vor allem veraltete Holzfeuerungsanlagen sind hier nach wie vor hauptverantwortlich für die relativ hohen Emissionen.

Die NMVOC Emissionen inklusive Kraftstoffexport beliefen sich im Jahr 1990 auf 334,0 kt. Bis zum Jahr 2018 nahmen sie um 67,9 % auf 107,2 kt ab. Zwischen 2017 und 2018 sanken die Emissionen um 3,2 %.

2.5.4 NH_3-Emissionen

Für das Jahr 2018 wurde ein Ausstoß von rund 64,4 kt NH_3 berechnet (ohne Kraftstoffexport). Im Jahr 1990 betrugen die NH_3-Emissionen ohne Kraftstoffexport 61,7 kt.

Von 1990 bis 2018 nahmen die NH_3-Emissionen (ohne Kraftstoffexport) um 4,4 % zu. Die österreichischen NH_3-Emissionen stammen nahezu ausschließlich vom Sektor Landwirtschaft (93,8 %). Die Emissionen unterliegen seit 1990 nur wenigen Veränderungen. Die leichte Zunahme der NH_3-Emissionen trotz eines etwas sinkenden Rinderbestandes lässt sich durch die vermehrte Haltung in Laufställen (aus Gründen des Tierschutzes und EU-rechtlich vorgeschrieben) und die Zunahme von leistungsstärkeren Milchkühen erklären. Außerdem kam es zu einem verstärkten Einsatz von Harnstoff als Stickstoffdünger.

Im Vergleich zum Vorjahr 2017 sanken die Emissionen um 1,0 kt (– 1,5 %). Hauptgrund ist die rückläufige Mineraldüngermenge, insbesondere von Harnstoff. Auch der niedrigere Rinder- und Schweinebestand wirkte sich emissionsmindernd aus. Der kleinere Milchkuhbestand wurde allerdings mit der gestiegenen Milchleistung kompensiert.

Die NH_3-Emissionen einschließlich Kraftstoffexport beliefen sich im Jahr 1990 auf 61,7 kt. Bis zum Jahr 2018 nahmen sie um 4,7 % auf 64,6 kt zu. Zwischen 2017 und 2018 gingen die Emissionen um 1,6 % zurück.

2.5.5 $PM_{2.5}$-Emissionen

Die $PM_{2.5}$-Emissionen ohne Kraftstoffexport betrugen im Jahr 2018 14,0 kt und im Jahr 1990 26,6 kt.

Seit 1990 nahmen die $PM_{2.5}$-Emissionen (ohne Kraftstoffexport) um 47,3 % ab. Größere Abnahmen gab es beim Hausbrand (1.A.4.b.1) wegen des stark reduzierten Kohleverbrauchs sowie bei den mobilen Landwirtschaftlichen Maschinen 1.A.4.c.2 (Agriculture/Forestry/Fishing: Off-road Vehicles and Other Machinery). Von 2013 auf 2014 gab es eine auffällige Reduktion der $PM_{2.5}$-Emissionen, die auf die sehr warme Witterung im Jahr 2014 und den damit verbundenen starken Rückgang des Biomasseeinsatzes in den Haushalten zurückzuführen ist. Die Wirtschaftskrise verursachte einen Einbruch der $PM_{2.5}$-Emissionen im Jahr 2009, der allerdings bereits 2010 durch die Erholung der Wirtschaft ausgeglichen wurde.

Von 2017 auf 2018 sind die $PM_{2.5}$-Emissionen (ohne Kraftstoffexport) um 1,0 kt (– 6,4 %) gesunken; hauptsächlich aufgrund von Reduktionen im Hausbrand (1 A 4 b 1 residential: stationary). Dieser nimmt 2018 mit rund 43 % den größten Anteil an den gesamten $PM_{2.5}$-Emissionen ein . Die Reduktion um 8 % zwischen 2017 und 2018 ergibt sich auf Grund der milden Witterung 2018 und einem Rückgang des Biomasseeinsatzes in den Heizungen. Zu einem geringen Teil kann die aktuelle Emissionsreduktion auch auf Effizienzverbesserungen durch thermische Sanierung und auf eine Umstellung auf moderne Biomasseheizungen (Verbesserung der Verbrennungstechnologie) zurückgeführt werden.

Die $PM_{2.5}$-Emissionen einschließlich Kraftstoffexport sind im Zeitraum 1990 bis 2018 um 47,5 % von 27,2 kt auf rund 14,3 kt gesunken. Verglichen mit 2017 beträgt der Rückgang im Jahr 2018 6,8 %.

3 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 2018. Trend tables 1990–2018 (SO_2, NO_x, NH_3, NMVOC and $PM_{2.5}$) for the main NFR sectors are presented in the following Annexes:

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

The complete tables in the NFR format have been uploaded to the Central Data Repository (CDR)[9] of EIONET in digital form (excel files).

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

4 EMISSION TRENDS

Austria reports official inventory data on the basis of fuel used (NECD 2016/2284, Annex IV). Thus, 'fuel export' emissions are not included in the Austrian total under the NEC Directive. Emission data based on fuel sold are listed in Annex 2 of this report.

4.1 Emissions not including 'fuel exports'

Table 1 and Figure 1 show the national total of the SO_2, NO_x, NH_3, NMVOC and $PM_{2.5}$ emissions not including fuel exports (fuel used).

If fuel prices vary between neighbouring countries, fuel bought in a Member State where it is sold at a cheaper price tends to be exported to (and used in) other countries. Austria has experienced a considerable amount of 'fuel exports' in the last few years; this needs to be taken into account when reporting emissions for the Austrian territory.

Details regarding 'fuel exports' are presented in Chapter 4.3.

Table 1: Austria's emissions 1990–2018 not including fuel exports. (Source: Umweltbundesamt)

	Austria's Air Emissions not including 'fuel exports' [Kilotons]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$**
1990	72.90	199.91	329.26	61.68	26.61
1995	45.85	180.09	244.98	63.06	24.99
2000	31.04	178.87	179.43	60.71	23.34
2001	31.81	181.89	172.54	60.64	23.40
2002	30.70	181.62	165.43	59.63	22.27
2003	30.43	186.13	161.23	59.52	21.86
2004	26.54	186.03	148.32	59.35	21.30
2005	25.90	189.41	152.63	59.24	21.09
2006	26.75	190.95	155.93	59.74	20.87
2007	23.41	187.28	151.77	61.05	20.16
2008	20.30	180.60	146.55	60.80	19.50
2009	14.76	168.03	133.31	62.22	18.40
2010	16.00	168.18	133.44	62.19	19.02
2011	15.20	166.85	128.40	61.72	18.08
2012	14.83	162.72	126.10	62.04	17.69
2013	14.40	159.61	120.34	62.16	17.12
2014	14.51	155.79	113.64	62.94	15.65
2015	13.95	153.92	110.48	63.72	15.53
2016	13.28	150.00	108.85	64.52	15.19
2017	12.81	143.42	109.94	65.39	14.98
2018	11.73	135.74	106.55	64.38	14.01

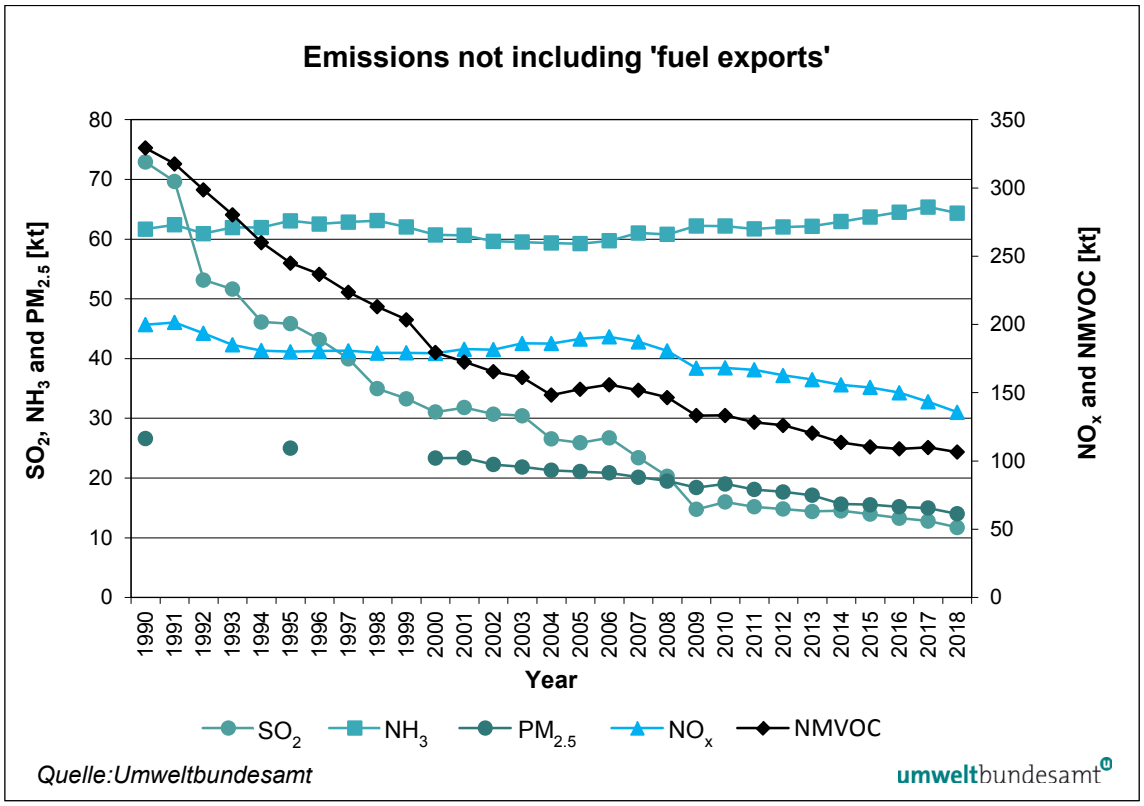

Figure 1: SO_2, NO_x, NMVOC, NH_3 and $PM_{2.5}$ emissions not including 'fuel exports'.

4.2 Emissions including 'fuel exports'

According to the 2013 Reporting Guidelines, Parties within the EMEP[10] region are required to calculate and report emissions in conformity with their national energy balances reported to Eurostat or the International Energy Agency (IEA). Emissions from road vehicle transport should therefore be calculated and reported on the basis of fuel sold.

Table 2 shows Austria's total emissions based on fuel sold.

Table 2: Austria's total emissions 1990–2018 including fuel exports. (Source: Umweltbundesamt)

	Austria's Total Emissions [Kilotons]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$**
1990	73.70	217.22	334.02	61.73	27.17
1995	46.81	197.88	246.57	63.11	25.69
2000	31.58	211.10	179.79	60.58	24.12
2001	32.46	221.81	174.09	60.66	24.38
2002	31.39	229.69	168.94	59.99	23.56

[10] EMEP – Co-operative programme for monitoring and evaluation of long-range transmission of air pollutants in Europe http://www.emep.int/

	Austria's Total Emissions [Kilotons]				
	SO_2	NO_x	NMVOC	NH_3	$PM_{2.5}$
2003	31.17	240.90	165.74	60.07	23.39
2004	26.60	240.59	152.83	59.94	22.83
2005	25.95	246.14	157.11	59.87	22.67
2006	26.79	236.09	159.25	60.32	22.17
2007	23.44	228.56	154.80	61.64	21.35
2008	20.33	215.12	148.94	61.31	20.44
2009	14.80	201.09	135.51	62.73	19.27
2010	16.04	202.15	135.41	62.69	19.87
2011	15.23	194.02	129.93	62.13	18.73
2012	14.86	188.87	127.42	62.41	18.27
2013	14.44	188.07	121.56	62.48	17.69
2014	14.54	179.43	114.63	63.23	16.11
2015	13.98	176.36	111.44	64.01	15.94
2016	13.32	170.30	109.73	64.81	15.56
2017	12.84	161.95	110.73	65.67	15.30
2018	11.77	150.86	107.22	64.63	14.26

4.3 Emissions from 'fuel exports'

In the year 2004, a study[11] was commissioned to analyse the effects of fuel price differences between Austria and its neighbouring countries, including the so-called 'fuel export' effect, which means that fuel which is sold in Austria is used abroad. Relevant calculations were based on extensive questionnaires (for truckers at the border and truckage companies), results from the Austrian transport model, and traffic counts. The importance of 'fuel exports' was confirmed by an update of the study in 2008/2009[12].

The following Table 3 provides information on the quantities of emissions that can be attributed to fuel exports in vehicle tanks. In 2018, about 10% of the reported NO_x emissions were due to 'fuel exports'.

[11] HAUSBERGER, S. & MOLITOR, R. (2004): Assessment of the effects of fuel tourism on fuel consumption and CO_2 emission trends in Austria (in German). TU Graz on behalf of the Austrian Ministry of Life, not published. Graz, 2004.

[12] HAUSBERGER, S.& MOLITOR, R. (2009): Assessment of the effects of fuel tourism on fuel consumption and CO_2 emission trends in Austria (in German). TU Graz on behalf of the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management and the Austrian Federal Ministry of Transport, Innovation and Technology, not published. Graz, 2009.

Table 3: NEC emissions from 'fuel exports'.

	Emissions [Kilotons]				
	SO_2	**NO_x**	**NMVOC**	**NH_3**	**$PM_{2.5}$**
1990	0.80	17.31	4.75	0.05	0.56
1995	0.96	17.79	1.60	0.05	0.71
2000	0.53	32.23	0.36	– 0.13	0.78
2001	0.64	39.92	1.55	0.02	0.99
2002	0.69	48.07	3.52	0.35	1.30
2003	0.74	54.77	4.51	0.55	1.52
2004	0.06	54.56	4.51	0.60	1.53
2005	0.05	56.74	4.49	0.63	1.58
2006	0.04	45.13	3.33	0.59	1.30
2007	0.04	41.28	3.04	0.60	1.19
2008	0.03	34.52	2.38	0.51	0.94
2009	0.03	33.06	2.21	0.51	0.87
2010	0.04	33.97	1.97	0.49	0.85
2011	0.03	27.17	1.52	0.41	0.65
2012	0.03	26.15	1.33	0.37	0.58
2013	0.04	28.45	1.22	0.33	0.57
2014	0.03	23.64	0.99	0.28	0.45
2015	0.03	22.44	0.96	0.29	0.42
2016	0.04	20.30	0.88	0.29	0.37
2017	0.04	18.53	0.79	0.28	0.32
2018	0.04	15.12	0.67	0.26	0.25

4.4 Description of trends

4.4.1 SO_2 emissions

In 2018, SO_2 emissions amounted to 11.7 kt (not including 'fuel exports'). Since 1990 (72.9 kt), emissions have decreased continuously.

SO_2 emissions (not including 'fuel exports') have decreased since 1990 by 83.9%. 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 SO_2 emissions (not including 'fuel exports') decreased by 1.1 kt (– 8.4%). This was mainly caused by maintenance-related production reductions in iron and steel industry (*1.A.2.a*, – 0.62 kt).

SO_2 emissions including ‘fuel exports‘ amounted to 73.7 kt in the year 1990 and decreased by 84.0% by 2018 (11.8 kt). Between 2017 and 2018 SO_2 emissions decreased by 8.4%.

4.4.2 NO_X emissions

In 1990, NO_x emissions without ‘fuel exports’ amounted to 199.9 kt, and in 2018 to 135.7 kt.

Since 1990, NO_x emissions (not including ‘fuel exports‘) have decreased by 32.1%. The reduction in NO_x emissions from 1991 to 1993 was mainly due to reductions in sector *1.A.3.b* (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 from 2008 to 2009.

From 2017 to 2018 the downward trend in NO_x emissions (not including ‘fuel exports‘) continued with a decrease of 7.7 kt (– 5.4%). This was caused by the decline in road traffic, especially of passenger cars (1.A.3.b.1) (– 2.1kt) and heavy duty vehicles (*1.A.3.b.3*) (– 1.6kt). The main share of the national NO_x emissions originates from fuel combustion. Road transport accounted for the biggest share of Austria's total NO_x emissions in the year 2018 with a contribution of 48.3%, not including ‘fuel exports’.

NO_x emissions including 'fuel exports' decreased from 1990 to 2018 by 30.5% from 217.2 kt to 150.9 kt. NO_x emissions including 'fuel exports’ showed extreme values in the years 2003 until 2005 and have since then decreased continuously. This is mainly due to reduced emissions from heavy trucks, especially because of improvements in the after treatment technology. Compared with 2017, emissions were 6.8% lower in the year 2018. Road transport had with 53.5%.the largest share of Austria's total NO_x emissions in the year 2018.

4.4.3 NMVOC emissions

NMVOC emissions without ‘fuel exports’ amounted to 329.3 kt in 1990, and to 106.6 kt in 2018. This represents a reduction of 67.6%. From 2017 to 2018 NMVOC emissions (not including ‘fuel exports‘) decreased by 3.4 kt (– 3.1%).

Since 1990, the largest reductions were achieved in the road transport sector due to an increased use of catalytic converters and diesel cars. Currently the transport sector contributes only a small share of 5% of total NMVOC emissions.

Reductions in the solvent sector were achieved due to various regulations (Solvent Ordinance, Cogeneration Act, VOC Emissions Ordinance). In 2018, this sector accounted for around 28% of total NMVOC emissions. Compared to the previous year, emissions fell slightly by 1%.

The agriculture sector accounted for the largest share of NMVOC emissions at 34%. Here emissions fell by 1% compared with 2017.

Residential stationary heating accounts for 21% of the total and has declined by 8% compared to 2017, mainly due to the warm weather.

In particular, outdated mixed-fuel wood boilers continue to be the main reason for the relatively high emissions.

NMVOC emissions including ‘fuel exports‘ amounted to 334.0 kt in the year 1990 and decreased by 67.9% by 2018 (107.2 kt). Between 2017 and 2018 NMVOC emissions decreased by 3.2%.

4.4.4 NH_3 emissions

NH_3 emissions without 'fuel exports' amounted to 61.7 kt in 1990, and to 64.4 kt in 2018.

Since 1990, NH_3 emissions (not including 'fuel exports') have increased by 4.4%. Austria's NH_3 emissions arise almost entirely from the agriculture sector (93.8%). There have been only slight changes in the emissions since 1990. The slight increase in NH_3 emissions (in spite of a decrease in the number of cattle) can be explained by an increase in loose housing systems (to ensure animal welfare and according to EU law) and an increase of high-capacity dairy cows. Additionally, there has been an increase in the use of urea as nitrogen fertiliser (a cost-efficient but otherwise less efficient fertiliser).

From 2017 to 2018 NH_3 emissions (not including 'fuel exports') decreased by 1.0 kt (– 1.5%). The main reason is the lower amount of mineral fertiliser, 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, the decrease of dairy cows was compensated with the rising milk yield.

NH_3 emissions including 'fuel exports' amounted to 61.7 kt in the year 1990 and increased by 4.7% by 2018 (64.6 kt). Between 2017 and 2018 NH_3 emissions decreased by 1.6%.

4.4.5 $PM_{2.5}$ emissions

$PM_{2.5}$ emissions without 'fuel exports' amounted to 26.6 kt in 1990, and to 14.0 kt in 2018.

Since 1990, the $PM_{2.5}$ emissions (not including 'fuel exports') have decreased by 47.3%. Large reductions were achieved through reduced coal consumption in households (*1.A.4.b.1*) and for off-road vehicles and other machinery in the agriculture and forestry sector (*1.A.4.c.2*). There was a remarkable reduction in $PM_{2.5}$ emissions from 2013 to 2014, mainly caused by the low number of heating degree days in 2014 and therefore less biomass consumption by residential space heating in 2014. The economic crisis in 2009 caused a decrease in emissions, followed by an increase due to the recovery of the economy.

From 2017 to 2018 $PM_{2.5}$ emissions (not including 'fuel exports') decreased by 1.0 kt (– 6.4%), mainly due to reductions in 1 A 4 b 1 residential: stationary. With a share of about 43%, it is the main source of total $PM_{2.5}$ emissions in 2018. The 8% reduction between 2017 and 2018 is 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).

$PM_{2.5}$ emissions including 'fuel exports' amounted to 27.2 kt in the year 1990 and decreased by 47.5% by 2018 (14.3 kt). Between 2017 and 2018 $PM_{2.5}$ emissions decreased by 6.8%.

5 METHOD OF REPORTING

5.1 Methodology

The Austrian air emission inventory for the period 1990 to 2018 has been compiled according to the revised Guidelines for Reporting Emissions and Projections Data as approved by the Executive Body for the UNECE/LRTAP Convention at its 32nd 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 the report at hand, NFR summary tables are presented in Annexes 1 and 2.

The following table summarizes the status of the present report:

Table 4: Status of the present report.

Format	Inventory	Version
NFR Format (UNECE)	OLI 2019	February 13th 2020

Data presented in this report are based on the Austrian Air Emission Inventory 2019 (Österreichische Luftschadstoff-Inventur, OLI 2019) prepared by the Umweltbundesamt for the years 1990 to 2018. The Austrian air emission inventory is subject to continuous improvement, resulting in recalculations as outlined in Chapter 6.

5.2 Sources of Data

Table 5 presents the main data sources used for activity data as well as information on who carried out the actual calculations.

Table 5: 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 growth rates of transport performance on Austrian roads from the Austrian Ministry for Transport, Technology and Innovation
	ZBD: Zentrale Beguchtachtungsdatenbank (yearly specific mileage)
	Flight movements from AustroControl

Sector	Data Sources for Activity Data
IPPU	National production statistics, import/export statistics; economic indicators EU-ETS; 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 obtained from Agrarmarkt Austria (AMA)
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 the IBE sector experts.

If the IBE's capabilities or resources are exceeded, some of the inventory activities are subcontracted, in some cases as a matter of routine (e.g. the emission inventory for road transport), in other cases they are subcontracted if required (e.g. revision of methodologies for a complex emission source). Subcontracts have so far been entered into with:

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

A final QC to assess whether the requirements have been fulfilled is performed by the IBE experts.

A detailed description of activity data, emission factors, and the methodologies applied will be provided in Austria's Informative Inventory Report (IIR) 2020, which is to be submitted under the UNECE Convention on Long-range Transboundary Air Pollution and NECD 2016/2284 on 15 March 2020.

6 RECALCULATIONS

Following the continuous improvements made to Austria's annual Air Emissions 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 2017 submitted this year may differ from the data reported previously.

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

	Recalculation Difference [%]			
	NEC		**LRTAP**	
	1990	**2017**	**1990**	**2017**
SO_2	– 0.11 %	0.23 %	– 0.09 %	0.27 %
NO_x	– 2.16 %	9.10 %	– 0.96 %	11.91 %
NMVOC	2.18 %	– 0.46 %	2.96 %	– 7.87 %
NH_3	– 5.33 %	– 4.65 %	– 5.30 %	– 4.96 %
$PM_{2.5}$	2.85 %	– 2.66 %	3.04 %	– 2.01 %

The most significant recalculations were made in the sectors 3 Agriculture and 1.A.3 Transport.

In the agriculture sector, the new EMEP/EEA Guidebook 2019 was implemented. 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 the transport sector, the new HBEFA Version 4.1 was implemented, which resulted in increased emission factors for all vehicle categories and in revised NOx emissions over the whole time series. Revisions were made in particular in the categories 1.A.3.b.1 Passenger cars and 1.A.3.b.2 Light duty vehicles. The emissions from passenger cars in 1990 are now estimated to be lower than in the previous inventory. For the year 2017 the emission estimates are higher. Methodological improvements in the category 1.A.3 have also led to revised NMVOC emissions.

In addition, NMVOC emissions for 2000 to 2017 have been revised downwards in the category Solvent Use (2.D.3). These emission reductions are the result of an elimination of inconsistencies due to in-depth QC activities.

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

6.1 ENERGY (1)

6.1.1 Revision of the energy balance

The federal office for national statistics, “Statistik Austria”, revised the energy balance for the years 1990 to 2017 with the following main implications for energy consumption as used in the inventory:

- Natural gas gross inland consumption 2014 and 2015 has been revised downwards by – 1 to – 1.8 TJ. However, natural gas consumption has been shifted to different sectors: For 2005 and 2006, about 1 to 1.2 PJ have been shifted from the power sector (1A1a) to the commercial sector (1A4a). For 2011, about 0.7 PJ have been shifted from the power sector (1A1a) to the commercial sector (1A4a). For 2013, about 1.7 PJ have been shifted from the commercial and residential sector (1A4a and 1A4b) to the industry sector (1A2). For 2014, about 1.1 PJ have been shifted from the residential and commercial sector (1A4a and 1A4b) to the industrial sector (1A2). For 2016, about 3 PJ have been shifted from petroleum refineries (1A1b) to the residential and industry sector (1A4b, 1A2).
- For liquid fuels, gross inland consumption has been revised downwards by – 0.1 to – 2.2 PJ for the years 2005 to 2011 (crude oil input into refineries) and by – 1.3 PJ 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, between 1.1 and 4.6 PJ of 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 (+ 1 PJ in 2005 and + 0.2 PJ in 2017).
- For ‘biomass’, gross inland consumption has been revised upwards for the whole time series 2005–2017 (2005: + 7 PJ, 2010: + 15.7 PJ, 2015: 9.4 PJ, 2017: + 14.5 PJ). For the years 2005 to 2016, transformation input to the power sector (1A1a) has been revised downwards (by – 0.4 to – 2.7 PJ) while for 2017 it has been revised upwards by + 3.5 PJ, 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 subcategories, with increases of + 6.4 PJ in 2005 and + 12.6 PJ in 2017.

6.2 Stationary combustion 1A1a-c, 1A2a-1A2g and 1A4a-1A4c

In general, recalculations follow the revisions of the energy balance. Revisions of methodologies are outlined in the paragraphs below.

Changes according to recommendations of the NECD Review 2019

Following a recommendation of the NECD 2019 review, SO_2 emissions from 5C1bv cremation have been estimated the first time.

Pulp and paper industry (1A2d)

Based on a new study performed in 2019, NO_x and $PM_{2.5}$ emission factors from hard coal, black liqueur and wood waste used in pulp and paper industries have been revised, resulting in NO_x emissions that are about – 0.8 kt lower and $PM_{2.5}$ emissions that are slightly higher for 2017.

Chemicals industry (1A2c)

NO_x, SO_2 and PM_{10} emissions from a large waste incineration plant are now based on measured data. This results in NO_x emissions from category 1A2c that are about – 0.1 kt lower, SO_2 emissions that are – 0.3 kt lower and $PM_{2.5}$ emissions that are – 0.2 kt lower for the year 2017.

Other sectors (1A4ai, 1A4bi, 1A4ci)

Changes according to a revision of the energy demand model for space heating

The module 'Heating type by technology' was updated with a new approach based on recent market data and expert consultation (on the sale of fuel technology). This information was used for remodelling the heating stock and turnover based on two studies, resulting in a revised consumption by type of heating.

Additionally, the mixed-fuel wood boiler stock was subdivided into two categories (advanced and conventional). Advanced technology is associated with (slightly) lower NO_x, NMVOC and $PM_{2.5}$ emissions than conventional equipment.

6.2.1 Road Transport (1.A.3.b)

Update of activity data

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).

Update/Improvement of methodology and emission factors

By using the latest version of the emission model "NEMO" from the Graz University of Technology for emission calculations, the following improvements to the model and to the input data were obtained, resulting in emission changes as described below:

- 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. This affects the categories PC, LDV and MC. In the case of cars, the analysis of this new data source led to the following findings:
  - Old vehicles are driven more than previously (and generally) assumed and
  - The specific mileage per car for each year of a vehicle's age is lower than previously assumed
  - These facts generally lead to a decrease in the total domestic mileage of passenger cars over the entire time series.

- New and improved emissions factors for all vehicle categories:
  - The most recent version of the emission calculation model NEMO (TU-Graz) includes the recently released emission factor database HBEFA 4.1. All consumption factors were checked or revised within this new software version.

    The implementation of the new HBEFA Version 4.1 resulted in an increase in emission factors for all vehicle categories. Due to dieselgate and the mandatory PEMS measurements for the Euro 6d_temp standard, large amounts of new measurement data have become available. New findings, such as the influence of ambient temperature on the functional efficiency of NO_x exhaust after-treatment systems (such as SCR), new aging conditions of such systems, new improved traffic situations combined with revised dynamic parameters, have led to an increase in the specific emissions for each vehicle category.

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

6.2.2 Coal mining and handling (1.B.1.a)

The recalculations of $PM_{2.5}$ emissions in category 1.B.1.a (Coal Mining and Handling) for the years 2005–2017 are due to a revision of the energy balance by Statistik Austria. This revision has led to an increase by 0.0004 kt $PM_{2.5}$ emissions in 2017.

6.2.3 Changes according to recommendations of the NECD Review 2018

Following a recommendation of the NECD 2019 review, NH_3 emissions from category *1.B.2.d Other fugitive emissions from energy production (Geothermal energy)* have been estimated.

6.3 INDUSTRIAL PROCESSES (2)

6.3.1.1 Wood processing (2.I)

Due to recalculations of the energy balances, the activity data had to be updated. Thus, particular matter emissions since 2005 have changed (– 0.001 kt $PM_{2.5}$ for 2017).

6.3.1.2 Other chemical industry (2.B.10.a)

Due to a transcription error, the NMVOC emissions of one chemical plant had to be revised for the whole time series (+ 0.008 kt NMVOC in 2017)

6.3.1.3 Solvent Use (2.D.3)

Following in-depth QC activities, time series inconsistencies in the solvents model were removed: (i) the reporting categories of the import/export statistics for various ethers had changed over time and have now been considered consistently; and (ii) for antifreeze fluids, of which not all reported in the category are relevant for VOC emissions, the same assumption as the one used in the years before has been applied. This has led to a decrease in activity data (Solvents Used), leading to a decrease in emissions.

6.3.1.4 Other product use (2.G)

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.

6.4 AGRICULTURE (3)

6.4.1.1 Livestock data (3.B, 3.D)

Livestock numbers of poultry and other animals (mainly deer) have been revised as new data has become available based on the final results of the farm structure survey 2016 (STATISTIK AUSTRIA 2018[13]). To avoid jumps in the time series, the years 2014 and 2015 have been interpolated. As currently no updated data is available for the respective livestock categories, the values of 2016 have been used for the years 2017 and 2018.

6.4.1.2 Detailed raw material and energy balances (3.D.a.2.c)

In 2019 new information on input materials for Austria's biogas plants became available (E-CONTROL 2019[14]) resulting in slightly revised amounts of digested manure and energy crops.

6.4.2 Methodological changes

6.4.2.1 Manure Management (3.B) – NH_3

The main reason for revised NH_3 emissions from manure management is the implementation of the new EMEP/EEA Guidebook 2019 in Austria's air emission inventory. The 2019 version of the Guidebook provides updated NH_3 emission factors for housing and storage for the livestock categories layers, broilers, sheep and other animals. Furthermore, the calculation method, which is based on the fraction of TAN that is immobilised in organic matter (f_{imm}) when the manure is managed as a litter-based solid and the litter is straw, has been revised. According to (EEA 2019), this immobilisation greatly reduces the potential NH_3-N emission during storage and after application.

The improved calculations resulted in lower NH_3 emissions from manure management for the whole time series (– 1.4 kt NH_3 in 2017)

6.4.2.2 Manure Management (3.B) – NO_x

NO_x emissions are calculated using a mass-flow approach based on the concept of a flow of TAN through the manure management system according to the EMEP/EEA GB 2019. Although there were no changes in the methodology for NO_x between the Guidebook versions 2016 and 2019, the revisions in the ammonia inventory (see Chapter 6.3.2.1) had an impact on NO_x and resulted in lower emissions for the whole time series (– 0.01 kt NO_x in 2017).

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

[14] E-CONTROL (2019): https://www.e-control.at/documents/1785851/1811582/%C3%96kostrombericht_FINAL.pdf/f689b909-2088-77b0-0c9e-eeb260effe7b?t=1569999423109 accessed in November 2019

6.4.2.3 Manure Management (3.B) – NMVOC

The NMVOC emission calculations according to the 2019 EMEP/EEA Tier 2 methodology are strongly linked to the compilation of the ammonia emissions inventory. Therefore, although there were no changes in the methodology for NMVOC between the Guidebook versions 2016 and 2019, the revisions to the ammonia inventory (see Chapter 6.3.2.1) also had an impact on NMVOC emissions. The improved calculations resulted in recalculations for the whole time series (+ 0.09 kt NMVOC in 2017).

6.4.2.4 Agricultural Soils (3.D) – NH_3

3.D.a.1 Inorganic N fertilisers

Revised emissions from inorganic N fertilisers are due to the implementation of new information on agriculture practice. Including the rapid incorporation of urea into the soil in Austria's calculations resulted in lower NH_3 emissions from synthetic fertiliser application for the entire time series (– 0.6 kt NH_3 in 2017).

3.D.a.2.a Animal manure applied to soils

NH_3 emissions of animal manure applied on soils have been revised downwards for the entire time series. The main reasons are updated NH_3 emission factors for manure spreading for the livestock categories layers and broilers according to the EMEP/EEA GB 2019, as well as improvements carried out in the manure management sector due to the new Guidebook (e.g. updated NH_3 emission factors and an improved calculation of the immobilised fraction of TAN, see Chapter 6.3.2.1). These changes led to a downward revision of the NH_3 emissions by – 1.3 kt for the year 2017.

3.D.a.3 Urine and dung deposited by grazing animals

According to the EMEP/EEA GB 2019, the default Tier 2 NH_3 EFs for grazing for the livestock categories sheep and other animals have been revised downwards compared to the 2016 GB. This results in lower NH_3 emissions for the whole time series (– 0.06 kt NH_3 in 2017).

6.4.2.5 Agricultural Soils (3.D) – NO_x

3.D.a.2.a Animal manure applied to soils

The revisions to the ammonia calculations according to the EMEP/EEA GB 2019 in the manure management sector have led to higher N amounts available for application (see Chapter 6.3.2.1). As a consequence, NO_x emissions of manure application have been resived upwards for the entire time series (+ 0.1 kt NO_x in 2017).

6.4.2.6 Agricultural Soils (3.D) – NMVOC

3.D.a.2.a Animal manure applied to soils

NMVOC emissions from manure application have been estimated based on the 2019 EMEP/EEA Tier 2 methodology which is closely linked to the compilation of the ammonia inventory. Therefore, the revisions to the ammonia inventory also had an impact on the NMVOC emissions and resulted in lower emissions for the entire time series (– 0.3 kt NMVOC in 2017).

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

Due to the application of the Tier 2 default EF according to the EMEP/EEA GB 2019 for open burning of agricultural wastes, there have been recalculations of NO_x, SO_2, NMVOC and PM emissions for the entire time series.

6.4.2.8 Biological treatment of waste (5.B) – NH_3

NH_3 emissions from anaerobic digestion at biogas facilities (5.B.2) are calculated in sector *3 Agriculture* but reported under sector *5 Waste*. The Tier 1 methodology of the EMEP/EEA Guidebook is applied. In the new EMEP/EEA GB 2019 the NH_3-N EF was changed from 0.0286 kg of NH_3-N to 0.0275 kg of NH_3-N, leading to a downward revision across the whole time series (– 0.02 kt NH_3 in 2017).

6.5 WASTE (5)

6.5.1 Update of activity data

6.5.1.1 Waste disposal on land (5.A)

Minor recalculations of particulate matter emissions from waste disposal (– 2.5 t TSP, – 1.2 t PM_{10}, – 0.4 t $PM_{2.5}$ in 2017) were caused by the correction of a transcription error.

6.5.1.2 Wastewater (5.D)

For NMVOC from category *5.D.1 domestic wastewater* a recalculation for 2017 was carried out (from 16.82 t to 16.09 t) 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.

6.5.1.3 Other waste (5.E)

Minor recalculations of particulate matter emissions for 2017 from category *5.E other waste* (+ 4.6 t TSP/PM_{10}/$PM_{2.5}$) were due to activity data becoming available (data on building fires 2017).

6.5.2 Update of emission factor

6.5.2.1 Biological Treatment (5.B)

NH_3 emissions from *5.B.2 anaerobic digestion* were recalculated for the whole time series (– 20.9 t in 2017) as the default emission factor for NH_3-N was adapted according to the new EMEP/EEA Guidebook.

ANNEX 1: 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.

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

Table A.I-1: SO_2 emissions [Kilotons] 1990–2018 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	70.89	68.89	2.00	1.93	0.01	0.07	NO	72.90	0.26
1991	67.99	66.69	1.30	1.61	0.00	0.06	NO	69.66	0.29
1992	51.74	49.74	2.00	1.36	0.00	0.04	NO	53.15	0.31
1993	50.48	48.38	2.10	1.11	0.00	0.04	NO	51.64	0.33
1994	44.97	43.69	1.28	1.12	0.00	0.05	NO	46.14	0.34
1995	44.73	43.20	1.53	1.07	0.01	0.05	NO	45.85	0.38
1996	42.14	40.94	1.20	0.99	0.00	0.05	NO	43.18	0.43
1997	38.95	38.88	0.07	0.96	0.00	0.05	NO	39.97	0.44
1998	34.04	34.00	0.04	0.87	0.00	0.06	NO	34.97	0.46
1999	32.40	32.35	0.04	0.81	0.01	0.06	NO	33.27	0.45
2000	30.20	30.16	0.04	0.78	0.00	0.06	NO	31.04	0.48
2001	31.04	30.99	0.05	0.71	0.01	0.06	NO	31.81	0.47
2002	29.93	29.89	0.04	0.71	0.01	0.06	NO	30.70	0.43
2003	29.66	29.61	0.05	0.71	0.00	0.06	NO	30.43	0.40
2004	25.75	25.71	0.04	0.72	0.01	0.06	NO	26.54	0.47
2005	25.11	25.07	0.04	0.72	0.00	0.06	NO	25.90	0.55
2006	25.97	25.92	0.05	0.73	0.00	0.05	NO	26.75	0.58
2007	22.62	22.56	0.05	0.75	0.00	0.04	NO	23.41	0.61
2008	19.48	19.44	0.04	0.78	0.00	0.03	NO	20.30	0.61
2009	14.04	13.98	0.06	0.70	0.00	0.02	NO	14.76	0.53
2010	15.28	15.23	0.05	0.70	0.00	0.01	NO	16.00	0.57
2011	14.50	14.46	0.05	0.68	0.00	0.01	NO	15.20	0.60
2012	14.17	14.12	0.05	0.65	0.00	0.01	NO	14.83	0.57
2013	13.80	13.76	0.04	0.59	0.00	0.01	NO	14.40	0.54
2014	13.95	13.91	0.04	0.55	0.00	0.01	NO	14.51	0.54
2015	13.37	13.33	0.04	0.57	0.00	0.01	NO	13.95	0.58
2016	12.70	12.68	0.02	0.57	0.00	0.01	NO	13.28	0.54
2017	12.22	12.19	0.04	0.57	0.00	0.01	NO	12.81	0.52
2018	11.15	11.12	0.02	0.57	0.00	0.01	NO	11.73	0.59

Table A.I-2: NO_x emissions [Kilotons] 1990–2018 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	183.48	183.48	IE	4.27	12.05	0.10	NO	199.91	2.44
1991	185.54	185.54	IE	3.93	11.99	0.09	NO	201.55	2.76
1992	177.78	177.78	IE	4.02	11.73	0.06	NO	193.58	3.00
1993	171.99	171.99	IE	1.46	11.57	0.05	NO	185.07	3.18
1994	168.03	168.03	IE	1.38	11.43	0.05	NO	180.89	3.31
1995	167.53	167.53	IE	0.90	11.61	0.05	NO	180.09	3.73
1996	168.07	168.07	IE	0.87	11.50	0.05	NO	180.48	4.14
1997	168.30	168.30	IE	0.86	11.57	0.05	NO	180.78	4.29
1998	166.60	166.60	IE	0.83	11.62	0.05	NO	179.10	4.43
1999	167.07	167.07	IE	0.82	11.27	0.05	NO	179.21	4.33
2000	166.91	166.91	IE	0.83	11.08	0.05	NO	178.87	6.44
2001	170.01	170.01	IE	0.78	11.05	0.05	NO	181.89	6.32
2002	169.72	169.72	IE	0.79	11.07	0.05	NO	181.62	5.67
2003	174.68	174.68	IE	0.81	10.59	0.05	NO	186.13	5.21
2004	175.23	175.23	IE	0.69	10.06	0.05	NO	186.03	6.09
2005	178.54	178.54	IE	0.70	10.12	0.05	NO	189.41	6.99
2006	180.16	180.16	IE	0.58	10.16	0.04	NO	190.95	7.54
2007	176.45	176.45	IE	0.48	10.31	0.04	NO	187.28	7.99
2008	169.11	169.11	IE	0.56	10.90	0.03	NO	180.60	7.90
2009	156.91	156.91	IE	0.41	10.69	0.02	NO	168.03	6.86
2010	157.84	157.84	IE	0.55	9.78	0.02	NO	168.18	7.60
2011	156.03	156.03	IE	0.52	10.28	0.02	NO	166.85	7.98
2012	151.76	151.76	IE	0.55	10.40	0.02	NO	162.72	7.68
2013	148.85	148.85	IE	0.45	10.29	0.02	NO	159.61	7.46
2014	144.72	144.72	IE	0.46	10.60	0.02	NO	155.79	7.49
2015	142.40	142.40	IE	0.52	10.99	0.02	NO	153.92	8.18
2016	138.29	138.29	IE	0.52	11.17	0.02	NO	150.00	10.28
2017	131.94	131.94	IE	0.47	10.99	0.02	NO	143.42	10.06
2018	124.56	124.56	IE	0.41	10.75	0.02	NO	135.74	11.54

Table A.I-3: NMVOC emissions [Kilotons] 1990–2018 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	158.38	142.89	15.49	118.54	52.19	0.16	NO	329.26	0.18
1991	154.30	139.18	15.12	112.01	51.21	0.16	NO	317.68	0.20
1992	144.59	129.40	15.19	105.25	48.54	0.15	NO	298.52	0.22
1993	134.49	119.83	14.65	98.55	47.26	0.15	NO	280.44	0.24
1994	121.13	110.01	11.12	91.99	46.79	0.14	NO	260.05	0.25
1995	113.32	103.83	9.49	85.28	46.25	0.14	NO	244.98	0.29
1996	107.88	99.41	8.46	83.72	45.10	0.13	NO	236.83	0.34
1997	96.87	88.91	7.95	82.37	44.33	0.13	NO	223.70	0.37
1998	87.88	81.44	6.43	81.06	43.99	0.13	NO	213.05	0.40
1999	81.77	76.10	5.67	78.32	43.28	0.12	NO	203.49	0.39
2000	74.89	69.20	5.69	62.15	42.27	0.12	NO	179.43	0.42
2001	70.64	66.81	3.84	59.96	41.82	0.11	NO	172.54	0.41
2002	65.27	61.24	4.03	59.11	40.94	0.11	NO	165.43	0.37
2003	62.15	58.19	3.96	58.53	40.44	0.11	NO	161.23	0.34
2004	58.25	54.68	3.57	49.80	40.16	0.11	NO	148.32	0.40
2005	55.70	52.35	3.34	57.32	39.50	0.11	NO	152.63	0.47
2006	53.37	50.01	3.36	63.26	39.19	0.10	NO	155.93	0.50
2007	50.66	47.68	2.98	61.94	39.07	0.10	NO	151.77	0.53
2008	48.96	46.20	2.75	58.71	38.79	0.10	NO	146.55	0.52
2009	46.35	43.76	2.59	47.89	38.98	0.09	NO	133.31	0.45
2010	48.07	45.62	2.45	46.70	38.58	0.09	NO	133.44	0.49
2011	44.37	41.96	2.41	46.03	37.92	0.08	NO	128.40	0.51
2012	44.28	41.88	2.40	44.13	37.61	0.08	NO	126.10	0.49
2013	43.82	41.52	2.30	38.87	37.58	0.07	NO	120.34	0.46
2014	39.13	36.71	2.42	36.81	37.63	0.07	NO	113.64	0.46
2015	39.62	37.30	2.32	33.37	37.43	0.06	NO	110.48	0.50
2016	39.04	36.77	2.27	32.33	37.42	0.06	NO	108.85	0.23
2017	38.61	36.32	2.29	33.96	37.31	0.06	NO	109.94	0.20
2018	35.89	33.72	2.17	33.63	36.97	0.06	NO	106.55	0.22

Table A.I-4: NH_3 emissions [Kilotons] 1990–2018 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	59.06	0.37	NO	61.68	0.00
1991	2.26	2.26	IE	0.58	59.18	0.38	NO	62.40	0.00
1992	2.48	2.48	IE	0.44	57.59	0.43	NO	60.94	0.00
1993	2.79	2.79	IE	0.29	58.37	0.52	NO	61.96	0.00
1994	2.98	2.98	IE	0.24	58.12	0.62	NO	61.95	0.00
1995	3.18	3.18	IE	0.17	59.08	0.64	NO	63.06	0.00
1996	3.48	3.48	IE	0.16	58.22	0.67	NO	62.53	0.00
1997	3.60	3.60	IE	0.16	58.44	0.67	NO	62.86	0.00
1998	3.75	3.75	IE	0.17	58.48	0.70	NO	63.10	0.00
1999	3.93	3.93	IE	0.19	57.15	0.77	NO	62.04	0.00
2000	3.88	3.88	IE	0.17	55.84	0.82	NO	60.71	0.00
2001	3.90	3.90	IE	0.15	55.67	0.92	NO	60.64	0.00
2002	3.69	3.69	IE	0.13	54.79	1.02	NO	59.63	0.00
2003	3.61	3.61	IE	0.14	54.67	1.10	NO	59.52	0.00
2004	3.45	3.45	IE	0.12	54.43	1.35	NO	59.35	0.00
2005	3.38	3.38	0.00	0.13	54.29	1.44	NO	59.24	0.00
2006	3.34	3.34	0.00	0.14	54.79	1.47	NO	59.74	0.00
2007	3.24	3.24	0.00	0.14	56.15	1.51	NO	61.05	0.00
2008	3.08	3.08	0.00	0.14	56.05	1.54	NO	60.80	0.00
2009	2.87	2.87	0.00	0.15	57.62	1.57	NO	62.22	0.00
2010	2.94	2.94	0.00	0.15	57.54	1.56	NO	62.19	0.00
2011	2.72	2.72	0.00	0.16	57.27	1.56	NO	61.72	0.00
2012	2.63	2.63	0.00	0.15	57.67	1.58	NO	62.04	0.00
2013	2.51	2.51	0.00	0.16	57.96	1.53	NO	62.16	0.00
2014	2.32	2.32	0.00	0.15	58.90	1.58	NO	62.94	0.00
2015	2.35	2.35	0.00	0.14	59.62	1.61	NO	63.72	0.00
2016	2.28	2.28	0.00	0.15	60.51	1.60	NO	64.52	0.00
2017	2.32	2.32	0.00	0.17	61.30	1.60	NO	65.39	0.00
2018	2.28	2.28	0.00	0.14	60.36	1.60	NO	64.38	0.00

Table A.I-5: $PM_{2.5}$ emissions [Kilotons] 1990–2018 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	22.19	22.08	0.11	3.82	0.36	0.23	NO	26.61	0.28
1995	21.23	21.14	0.09	3.17	0.36	0.24	NO	24.99	0.42
2000	19.81	19.72	0.09	2.96	0.34	0.23	NO	23.34	0.52
2001	19.96	19.87	0.09	2.86	0.35	0.23	NO	23.40	0.51
2002	19.21	19.11	0.10	2.49	0.34	0.23	NO	22.27	0.46
2003	18.86	18.76	0.10	2.43	0.33	0.24	NO	21.86	0.43
2004	18.27	18.18	0.09	2.40	0.38	0.24	NO	21.30	0.51
2005	18.23	18.14	0.09	2.32	0.33	0.21	NO	21.09	0.59
2006	18.25	18.17	0.09	2.09	0.32	0.21	NO	20.87	0.63
2007	17.67	17.59	0.08	1.89	0.33	0.26	NO	20.16	0.66
2008	16.94	16.86	0.08	1.99	0.32	0.25	NO	19.50	0.66
2009	15.98	15.93	0.06	1.85	0.32	0.25	NO	18.40	0.57
2010	16.54	16.47	0.07	1.87	0.31	0.29	NO	19.02	0.62
2011	15.59	15.51	0.07	1.91	0.30	0.29	NO	18.08	0.65
2012	15.26	15.19	0.07	1.85	0.28	0.30	NO	17.69	0.62
2013	14.74	14.67	0.07	1.84	0.28	0.26	NO	17.12	0.59
2014	13.21	13.14	0.06	1.85	0.28	0.31	NO	15.65	0.59
2015	13.15	13.08	0.07	1.78	0.28	0.33	NO	15.53	0.63
2016	12.82	12.75	0.06	1.78	0.28	0.31	NO	15.19	0.70
2017	12.60	12.53	0.07	1.78	0.28	0.32	NO	14.98	0.67
2018	11.74	11.68	0.06	1.72	0.27	0.28	NO	14.01	0.76

ANNEX 2: 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.

Table A.II-1: SO_2 emissions [Kilotons] 1990–2018 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	0.01	0.07	NO	73.70	0.26
1991	69.05	67.75	1.30	1.61	0.00	0.06	NO	70.72	0.29
1992	52.79	50.79	2.00	1.36	0.00	0.04	NO	54.19	0.31
1993	51.66	49.56	2.10	1.11	0.00	0.04	NO	52.82	0.33
1994	46.02	44.74	1.28	1.12	0.00	0.05	NO	47.19	0.34
1995	45.69	44.16	1.53	1.07	0.01	0.05	NO	46.81	0.38
1996	42.89	41.69	1.20	0.99	0.00	0.05	NO	43.93	0.43
1997	39.38	39.31	0.07	0.96	0.00	0.05	NO	40.40	0.44
1998	34.70	34.66	0.04	0.87	0.00	0.06	NO	35.63	0.46
1999	32.87	32.82	0.04	0.81	0.01	0.06	NO	33.74	0.45
2000	30.74	30.69	0.04	0.78	0.00	0.06	NO	31.58	0.48
2001	31.68	31.64	0.05	0.71	0.01	0.06	NO	32.46	0.47
2002	30.62	30.58	0.04	0.71	0.01	0.06	NO	31.39	0.43
2003	30.40	30.36	0.05	0.71	0.00	0.06	NO	31.17	0.40
2004	25.81	25.77	0.04	0.72	0.01	0.06	NO	26.60	0.47
2005	25.17	25.13	0.04	0.72	0.00	0.06	NO	25.95	0.55
2006	26.01	25.96	0.05	0.73	0.00	0.05	NO	26.79	0.58
2007	22.65	22.60	0.05	0.75	0.00	0.04	NO	23.44	0.61
2008	19.51	19.47	0.04	0.78	0.00	0.03	NO	20.33	0.61
2009	14.07	14.02	0.06	0.70	0.00	0.02	NO	14.80	0.53
2010	15.32	15.27	0.05	0.70	0.00	0.01	NO	16.04	0.57
2011	14.53	14.49	0.05	0.68	0.00	0.01	NO	15.23	0.60
2012	14.20	14.16	0.05	0.65	0.00	0.01	NO	14.86	0.57
2013	13.84	13.80	0.04	0.59	0.00	0.01	NO	14.44	0.54
2014	13.98	13.94	0.04	0.55	0.00	0.01	NO	14.54	0.54
2015	13.40	13.36	0.04	0.57	0.00	0.01	NO	13.98	0.58
2016	12.74	12.71	0.02	0.57	0.00	0.01	NO	13.32	0.54
2017	12.26	12.22	0.04	0.57	0.00	0.01	NO	12.84	0.52
2018	11.18	11.16	0.02	0.57	0.00	0.01	NO	11.77	0.59

Table A.II-2: NO_x emissions [Kilotons] 1990–2018 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	200.79	200.79	IE	4.27	12.05	0.10	NO	217.22	2.44
1991	210.73	210.73	IE	3.93	11.99	0.09	NO	226.75	2.76
1992	199.51	199.51	IE	4.02	11.73	0.06	NO	215.32	3.00
1993	193.70	193.70	IE	1.46	11.57	0.05	NO	206.77	3.18
1994	185.71	185.71	IE	1.38	11.43	0.05	NO	198.56	3.31
1995	185.33	185.33	IE	0.90	11.61	0.05	NO	197.88	3.73
1996	203.27	203.27	IE	0.87	11.50	0.05	NO	215.68	4.14
1997	189.42	189.42	IE	0.86	11.57	0.05	NO	201.89	4.29
1998	201.18	201.18	IE	0.83	11.62	0.05	NO	213.68	4.43
1999	193.29	193.29	IE	0.82	11.27	0.05	NO	205.43	4.33
2000	199.14	199.14	IE	0.83	11.08	0.05	NO	211.10	6.44
2001	209.94	209.94	IE	0.78	11.05	0.05	NO	221.81	6.32
2002	217.78	217.78	IE	0.79	11.07	0.05	NO	229.69	5.67
2003	229.45	229.45	IE	0.81	10.59	0.05	NO	240.90	5.21
2004	229.79	229.79	IE	0.69	10.06	0.05	NO	240.59	6.09
2005	235.27	235.27	IE	0.70	10.12	0.05	NO	246.14	6.99
2006	225.30	225.30	IE	0.58	10.16	0.04	NO	236.09	7.54
2007	217.73	217.73	IE	0.48	10.31	0.04	NO	228.56	7.99
2008	203.63	203.63	IE	0.56	10.90	0.03	NO	215.12	7.90
2009	189.97	189.97	IE	0.41	10.69	0.02	NO	201.09	6.86
2010	191.80	191.80	IE	0.55	9.78	0.02	NO	202.15	7.60
2011	183.20	183.20	IE	0.52	10.28	0.02	NO	194.02	7.98
2012	177.91	177.91	IE	0.55	10.40	0.02	NO	188.87	7.68
2013	177.30	177.30	IE	0.45	10.29	0.02	NO	188.07	7.46
2014	168.35	168.35	IE	0.46	10.60	0.02	NO	179.43	7.49
2015	164.84	164.84	IE	0.52	10.99	0.02	NO	176.36	8.18
2016	158.59	158.59	IE	0.52	11.17	0.02	NO	170.30	10.28
2017	150.47	150.47	IE	0.47	10.99	0.02	NO	161.95	10.06
2018	139.68	139.68	IE	0.41	10.75	0.02	NO	150.86	11.54

Table A.II-3: NMVOC emissions [Kilotons] 1990–2018 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	163.13	147.64	15.49	118.54	52.19	0.16	NO	334.02	0.18
1991	164.92	149.80	15.12	112.01	51.21	0.16	NO	328.31	0.20
1992	150.76	135.58	15.19	105.25	48.54	0.15	NO	304.70	0.22
1993	138.71	124.06	14.65	98.55	47.26	0.15	NO	284.67	0.24
1994	123.30	112.18	11.12	91.99	46.79	0.14	NO	262.22	0.25
1995	114.91	105.43	9.49	85.28	46.25	0.14	NO	246.57	0.29
1996	108.25	99.78	8.46	83.72	45.10	0.13	NO	237.20	0.34
1997	96.18	88.22	7.95	82.37	44.33	0.13	NO	223.01	0.37
1998	89.40	82.97	6.43	81.06	43.99	0.13	NO	214.58	0.40
1999	81.77	76.10	5.67	78.32	43.28	0.12	NO	203.49	0.39
2000	75.26	69.57	5.69	62.15	42.27	0.12	NO	179.79	0.42
2001	72.20	68.36	3.84	59.96	41.82	0.11	NO	174.09	0.41
2002	68.78	64.75	4.03	59.11	40.94	0.11	NO	168.94	0.37
2003	66.65	62.70	3.96	58.53	40.44	0.11	NO	165.74	0.34
2004	62.76	59.19	3.57	49.80	40.16	0.11	NO	152.83	0.40
2005	60.18	56.84	3.34	57.32	39.50	0.11	NO	157.11	0.47
2006	56.69	53.34	3.36	63.26	39.19	0.10	NO	159.25	0.50
2007	53.70	50.71	2.98	61.94	39.07	0.10	NO	154.80	0.53
2008	51.34	48.59	2.75	58.71	38.79	0.10	NO	148.94	0.52
2009	48.55	45.97	2.59	47.89	38.98	0.09	NO	135.51	0.45
2010	50.05	47.59	2.45	46.70	38.58	0.09	NO	135.41	0.49
2011	45.90	43.49	2.41	46.03	37.92	0.08	NO	129.93	0.51
2012	45.60	43.20	2.40	44.13	37.61	0.08	NO	127.42	0.49
2013	45.04	42.73	2.30	38.87	37.58	0.07	NO	121.56	0.46
2014	40.12	37.71	2.42	36.81	37.63	0.07	NO	114.63	0.46
2015	40.57	38.25	2.32	33.37	37.43	0.06	NO	111.44	0.50
2016	39.92	37.65	2.27	32.33	37.42	0.06	NO	109.73	0.23
2017	39.40	37.12	2.29	33.96	37.31	0.06	NO	110.73	0.20
2018	36.56	34.39	2.17	33.63	36.97	0.06	NO	107.22	0.22

Table A.II-4: NH_3 emissions [Kilotons] 1990–2018 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	59.06	0.37	NO	61.73	0.00
1991	2.43	2.43	IE	0.58	59.18	0.38	NO	62.57	0.00
1992	2.62	2.62	IE	0.44	57.59	0.43	NO	61.08	0.00
1993	2.90	2.90	IE	0.29	58.37	0.52	NO	62.07	0.00
1994	3.04	3.04	IE	0.24	58.12	0.62	NO	62.02	0.00
1995	3.23	3.23	IE	0.17	59.08	0.64	NO	63.11	0.00
1996	3.40	3.40	IE	0.16	58.22	0.67	NO	62.46	0.00
1997	3.47	3.47	IE	0.16	58.44	0.67	NO	62.73	0.00
1998	3.77	3.77	IE	0.17	58.48	0.70	NO	63.11	0.00
1999	3.80	3.80	IE	0.19	57.15	0.77	NO	61.91	0.00
2000	3.75	3.75	IE	0.17	55.84	0.82	NO	60.58	0.00
2001	3.92	3.92	IE	0.15	55.67	0.92	NO	60.66	0.00
2002	4.05	4.05	IE	0.13	54.79	1.02	NO	59.99	0.00
2003	4.16	4.16	IE	0.14	54.67	1.10	NO	60.07	0.00
2004	4.04	4.04	IE	0.12	54.43	1.35	NO	59.94	0.00
2005	4.01	4.01	0.00	0.13	54.29	1.44	NO	59.87	0.00
2006	3.93	3.93	0.00	0.14	54.79	1.47	NO	60.32	0.00
2007	3.84	3.84	0.00	0.14	56.15	1.51	NO	61.64	0.00
2008	3.58	3.58	0.00	0.14	56.05	1.54	NO	61.31	0.00
2009	3.39	3.39	0.00	0.15	57.62	1.57	NO	62.73	0.00
2010	3.43	3.43	0.00	0.15	57.54	1.56	NO	62.69	0.00
2011	3.13	3.13	0.00	0.16	57.27	1.56	NO	62.13	0.00
2012	3.00	3.00	0.00	0.15	57.67	1.58	NO	62.41	0.00
2013	2.84	2.84	0.00	0.16	57.96	1.53	NO	62.48	0.00
2014	2.60	2.60	0.00	0.15	58.90	1.58	NO	63.23	0.00
2015	2.64	2.64	0.00	0.14	59.62	1.61	NO	64.01	0.00
2016	2.57	2.57	0.00	0.15	60.51	1.60	NO	64.81	0.00
2017	2.60	2.60	0.00	0.17	61.30	1.60	NO	65.67	0.00
2018	2.54	2.54	0.00	0.14	60.36	1.60	NO	64.63	0.00

Table A.II-5: $PM_{2.5}$ emissions [Kilotons] 1990–2018 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	22.76	22.65	0.11	3.82	0.36	0.23	NO	27.17	0.28
1995	21.93	21.85	0.09	3.17	0.36	0.24	NO	25.69	0.42
2000	20.60	20.51	0.09	2.96	0.34	0.23	NO	24.12	0.52
2001	20.95	20.86	0.09	2.86	0.35	0.23	NO	24.38	0.51
2002	20.51	20.41	0.10	2.49	0.34	0.23	NO	23.56	0.46
2003	20.39	20.28	0.10	2.43	0.33	0.24	NO	23.39	0.43
2004	19.81	19.72	0.09	2.40	0.38	0.24	NO	22.83	0.51
2005	19.81	19.72	0.09	2.32	0.33	0.21	NO	22.67	0.59
2006	19.55	19.47	0.09	2.09	0.32	0.21	NO	22.17	0.63
2007	18.87	18.79	0.08	1.89	0.33	0.26	NO	21.35	0.66
2008	17.88	17.80	0.08	1.99	0.32	0.25	NO	20.44	0.66
2009	16.85	16.79	0.06	1.85	0.32	0.25	NO	19.27	0.57
2010	17.39	17.32	0.07	1.87	0.31	0.29	NO	19.87	0.62
2011	16.24	16.17	0.07	1.91	0.30	0.29	NO	18.73	0.65
2012	15.84	15.77	0.07	1.85	0.28	0.30	NO	18.27	0.62
2013	15.31	15.24	0.07	1.84	0.28	0.26	NO	17.69	0.59
2014	13.66	13.60	0.06	1.85	0.28	0.31	NO	16.11	0.59
2015	13.56	13.49	0.07	1.78	0.28	0.33	NO	15.94	0.63
2016	13.18	13.12	0.06	1.78	0.28	0.31	NO	15.56	0.70
2017	12.92	12.86	0.07	1.78	0.28	0.32	NO	15.30	0.67
2018	11.99	11.93	0.06	1.72	0.27	0.28	NO	14.26	0.76

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The report on Austria's Annual Air Emission Inventory 1990–2018, compiled by the Umweltbundesamt (Environment Agency Austria), provides a summary of Austria's SO_2, NO_x, NH_3, NMVOC and $PM_{2.5}$ emissions for the years 1990 to 2018.

The report includes first information on emission trends and performed recalculations for the years 1990 and 2018. More detailed descriptions will be provided in Austria's Informative Inventory Report (IIR) 2020, which is to be submitted under the NEC Directive on 15 March 2020.

The results of the calculations compiled in the report show that between 2017 and 2018 the emissions of all NEC pollutants decreased: emissions of sulphur dioxide (SO_2) decreased by 8.4 %, nitrogen oxide emissions (NO_x) decreased by 5.4 %, non-methane volatile organic compounds (NMVOCs) decreased by 3.1 %, ammonia emissions (NH_3) decreased by 1.5 % and particulate matter ($PM_{2.5}$) decreased by 6.4 %.

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