umweltbundesamt

Austria's National Air Emission Projections for 2010

Submission under Directive 2001/81/EC (NEC Directive)

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(NEC Directive)

Final Report

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1 REPORTING OBLIGATIONS

This report presents emission projections for 2010, as required by Article 8 of the NEC Directive to be reported to the European Commission and the European Environment Agency. It includes background information to enable a quantitiative understanding of the key socioeconomic assumptions used in the preparation of the projections.

For comparison, this report also includes emission data from the 2004 national air emission inventory on which the projections were based. For latest inventory data, please see the 2005 emission inventory at:

http://www.umweltbundesamt.at/umweltschutz/luft/emiberichte/ .

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Legal background

After the UN/ECE Gothenburg Protocol to the Convention on Long-Range Transboundary Air Pollution had been signed on 1 December 1999, the EU agreed on national emission ceilings for sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and non-methane volatile organic compounds (NMVOC) for the year 2010.

The Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants ("NEC Directive") implements national emission ceilings for these air pollutants[1]. Pursuant to Article 7 Member States are obliged to prepare and annually update national emission inventories and emission projections for 2010. Pursuant to Art. 8 (1) Member States have to report their emission inventories and projections to the Commission. The obligations have been transposed into national law by the Emissionshöchstmengengesetz-Luft[2].

[1] Directive 2001/81/EC of the European Parliament and the Council of 23 October 2001 concerning national emission ceilings for certain pollutants, OJ L309/22, 27 November 2001.

[2] Bundesgesetz über nationale Emissionshöchstmengen für bestimmte Luftschadstoffe (Emissionshöchstmengengesetz-Luft, EG-L), BGBl. Nr. 34/2003.

2 EMISSIONS

In the Emission Reporting Guidelines 2002, Parties are given the choice of whether to report emissions on the basis of fuel used or fuel sold to the final consumer. It is recommended that they state clearly in their submissions the basis of their calculations. Table 1 shows national total emissions as reported to the UNECE Convention on Long-range Transboundary Air Pollution, based on fuel sold.

Table 1: Austrian national total emissions for 1990, 1995, 2000, 2003 and projected emissions for 2010 after implementation of agreed policy for Austria [in 1000 tons per year, i.e. kt/a]

Pollutants	***Emission data on which projections 2010 were based (*)***				***Projection***
	1990	**1995**	**2000**	**2003**	**2010**
NO_x	210,99	192,13	204,43	229,03	172,94
SO_2	76,18	48,21	33,06	34,14	25,62
NMVOC	286,02	221,31	181,01	182,30	152,18
NH_3	57,15	59,42	54,93	54,49	52,89

(*) Projections were based on emission data from the 2004 emission inventory. For latest inventory data, please see the 2005 emission inventory at:
http://www.umweltbundesamt.at/umweltschutz/ luft/emiberichte/

Chapters 2.1 up to 2.4 of this report present projection tables for SO_x, NO_x, NH_3 and NMVOCs for the main NFR sectors as reported to the UNECE Convention on Long-range Transboundary Air Pollution, calculating transport emissions from sold fuel.

According to Article 2 of Directive 2001/81/EC the Directive covers "emissions in the territory of the Member States". If fuel prices are considerably different in neighbouring countries, fuel sold within the territory of a Member State is used outside its territory (the so-called "tank tourism"). Austria has experienced a considerable amount of "tank tourism" in the last few years; this needs to be taken into account for reporting emissions on the Austrian territory. Most of these fuels are currently used in heavy duty vehicles for long-distance traffic (inside and outside the EU). Austria reports emissions without "tank tourism" according to Table 2 as Austria's official projection under Article 8 (1) of the NEC-Directive.

Table 2: Austria's emission projection according to Directive 2001/81/EC and ceilings for 2010

	Emissions 2010 without "tank tourism" [kt/a]	**Ceilings 2010 [kt/a]**
NO_X	137,32	103
SO_2	25,58	39
NMVOC	149,57	159
NH_3	52,79	66

The comparison with Table 1 shows that "tank tourism" is of significant relevance for NO_X emissions only.

2.1 Nitrogen Oxides NO_x

The main source for NO_x emissions in Austria with a share of more than 95% is fuel combustion actitivities. Within this source road transport is the major contributor to total NO_x emissions; over the years about 50% of national total emissions have arisen from this source.

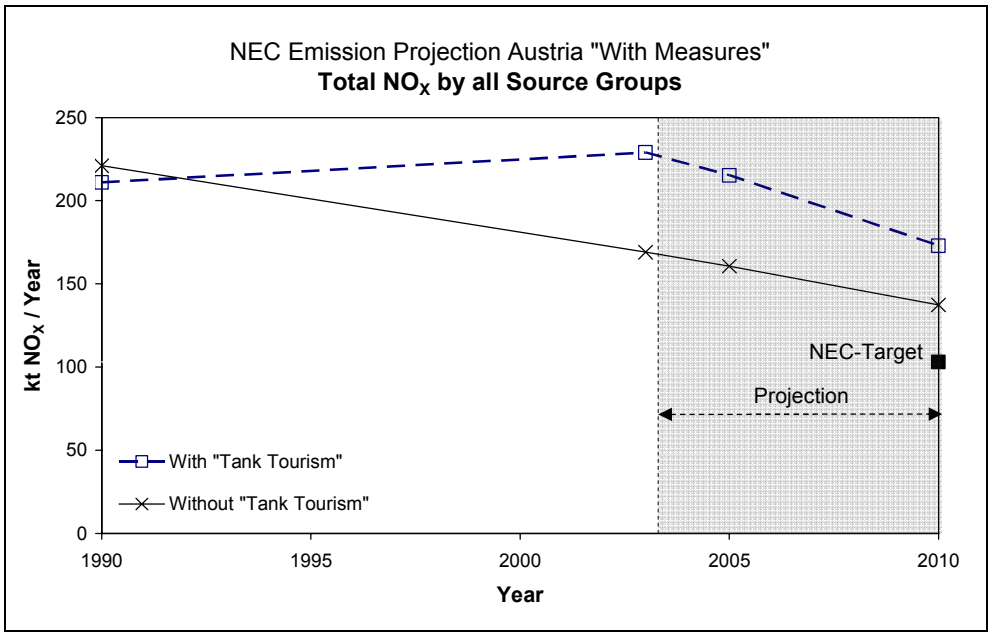


Figure 1: Historical and projected emissions of NO_x in comparison to the national emissions ceiling.

The projections for 2010 based on current legislation show a remarkable reduction of NO_x emissions, mainly due to a decrease of transport emissions. National total emissions are expected to decrease to 173 kt (kilo tons, i.e. 1000 tons), emissions without "tank tourism" to 137 kt. However the emissions without "tank tourism" are still projected to significantly exceed the emission ceiling of 103 kt by more than 30 kt.

Table 3: Austria's NO_x emission projection for 2005 and 2010

NEC GAS SOURCE CATEGORIES		NO_X [kt]			
		1990	2003	2005	2010
	National Total with "Tank Tourism"	**210,99**	**229,03**	**215,32**	**172,94**
	National Total without "Tank Tourism"	*221,03*	*169,05*	*160,62*	*137,32*
1 A 1, 1 B	**Energy Industries and Fugitive Emissions**	**16,87**	**15,64**	**14,32**	**14,88**
1 A 1	Energy Industries	16,87	15,64	14,32	14,88
1 B 1	Solid fuels	NA	NA	NA	NA
1 B 2	Oil and natural gas	IE	IE	IE	IE
1 A 2	**Manufacturing Industries and Construction**	**43,00**	**33,49**	**34,36**	**31,15**
1 A 2	Manufacturing Industries and Construction	43,00	33,49	34,36	31,15
1 A 3	**Transport**	**103,36**	**135,69**	**126,57**	**90,18**
1 A 3	Transport	103,36	135,69	126,57	90,18
1 A 4, 1 A 5	**Buildings and Other**	**37,52**	**37,78**	**34,70**	**31,29**
1 A 4 a	Commercial/Institutional	3,22	2,12	1,93	1,71
1 A 4 b	Residential	14,50	15,99	15,11	14,20
1 A 4 c	Agriculture/Forestry/Fisheries	19,72	19,60	17,58	15,29
1 A 5	Other	0,08	0,08	0,09	0,09
2, 3	**Industrial Processes with Solvent and Other Product Use**	**4,80**	**1,66**	**0,82**	**0,84**
2 A	Mineral Products	NA	NA	NA	NA
2 B	Chemical Industry	4,07	0,69	0,73	0,75
2 C	Metal Production	0,17	0,09	0,09	0,09
2 D	Other Production	0,55	0,88	IE, NA	IE, NA
2 G	Other	NA	NA	NA	NA
3	Solvent and other Product Use	NA	NA	0,00	0,00
4	**Agriculture**	**5,41**	**4,76**	**4,52**	**4,57**
4 B	Manure Management	NA	NA	NA	NA
4 C	Rice Cultivation	NO	NO	NO	NO
4 D	Agricultural Soils	5,37	4,73	4,49	4,53
4 F	Field Burning of Agricultural Residues	0,03	0,03	0,03	0,03
4 G	Other	NO	NO	NO	NO
6	**Waste Management**	**0,04**	**0,03**	**0,03**	**0,03**
6 A	Solid Waste Disposal on Land	NA	NA	NA	NA
6 B	Wastewater Handling	NA	NA	NA	NA
6 C	Waste Incineration	0,04	0,03	0,03	0,03
6 D	Other Waste	NA	NA	NA	NA
I B Av	International Bunkers (Aviation)	2,77	4,64	5,81	6,95
I B Mar	International Bunkers (Marine)	NO	NO	NO	NO

IE … included elsewhere; NA… not applicable; NO … not occurring

Sectoral emission projection of nitrogen oxides

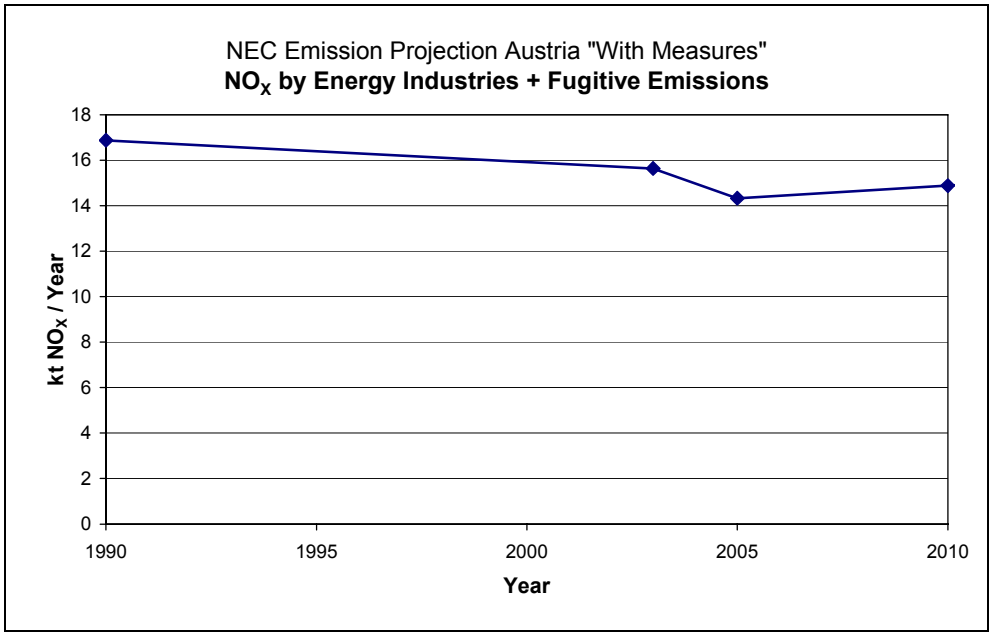


Figure 2: NOx from energy industries and fugitive emissions, 1990-2010

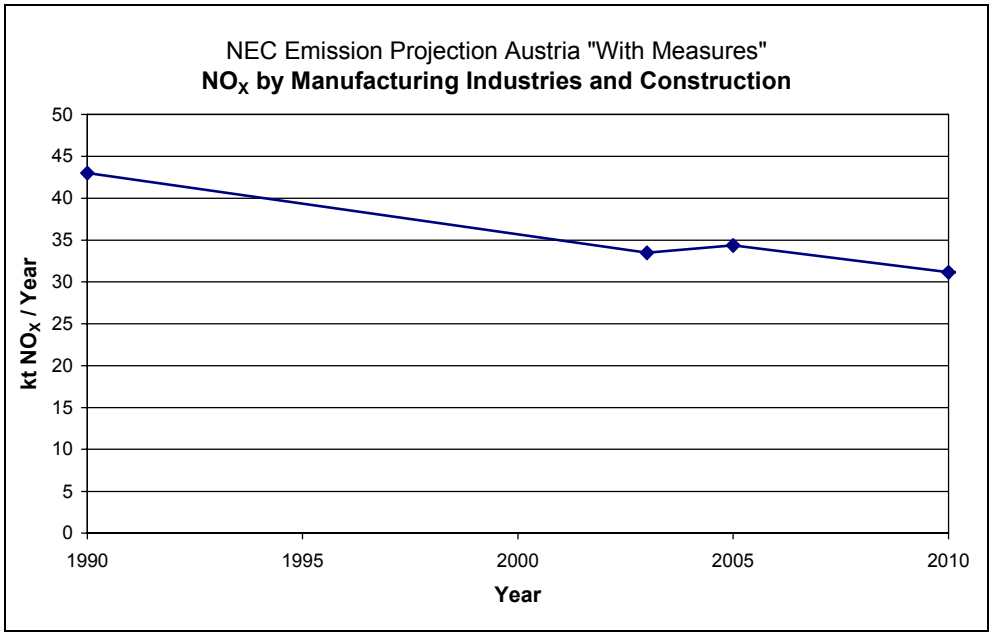


Figure 3: NOx from manufacturing industries and construction, 1990-2010

Figure 4: NOx from transport, 1990-2010

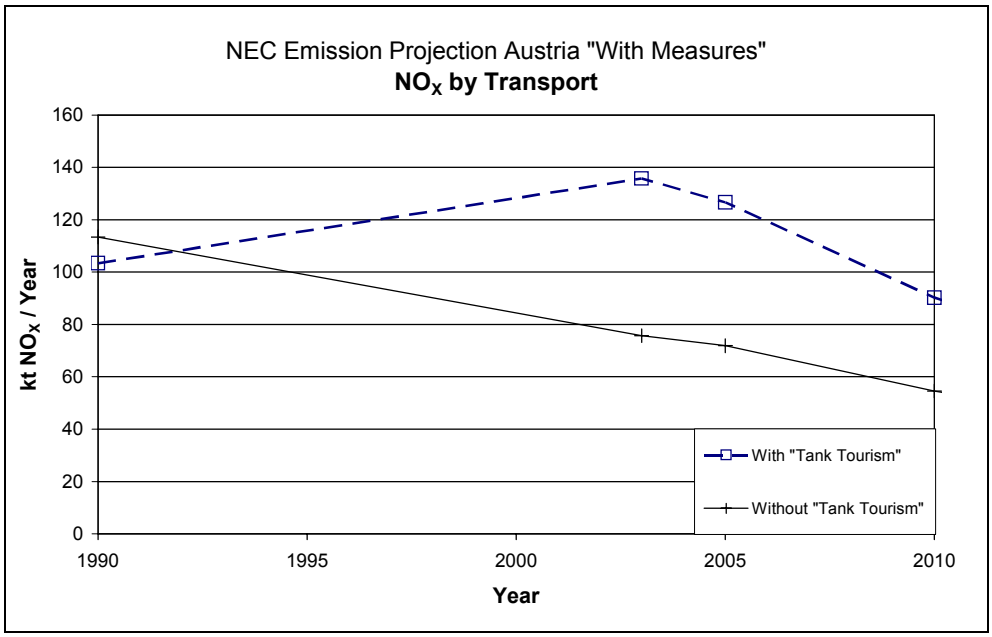
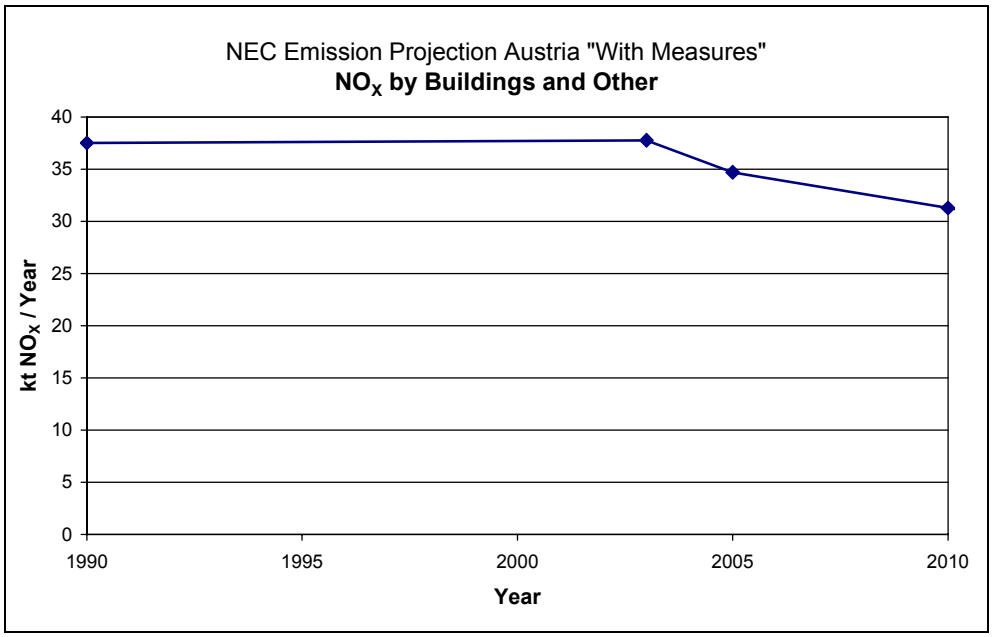


Figure 5: NOx from buildings and other, 1990-2010



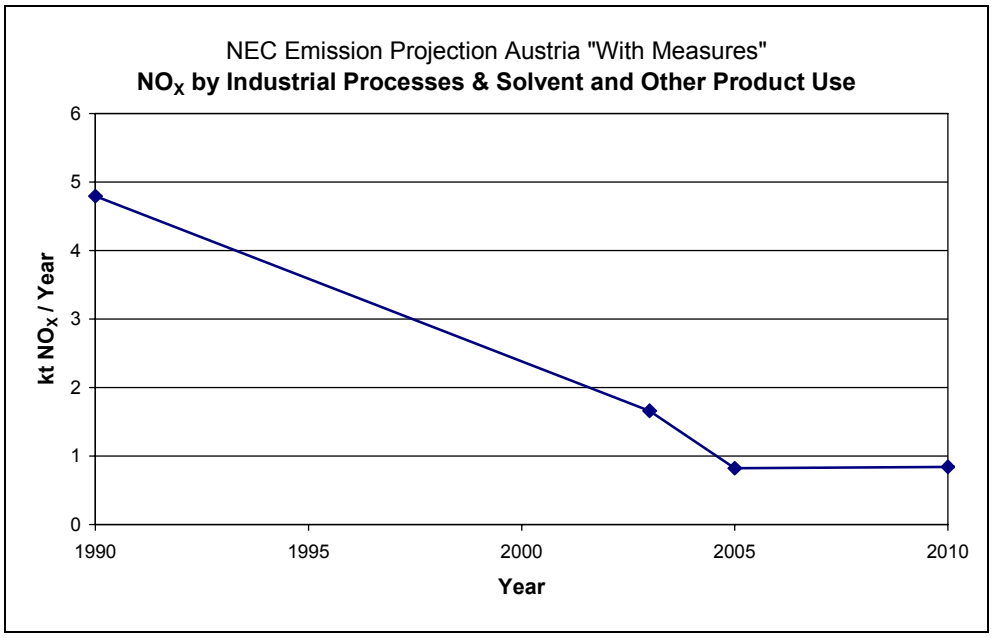


Figure 6: NOx from industrial processes and solvent and other product use, 1990-2010

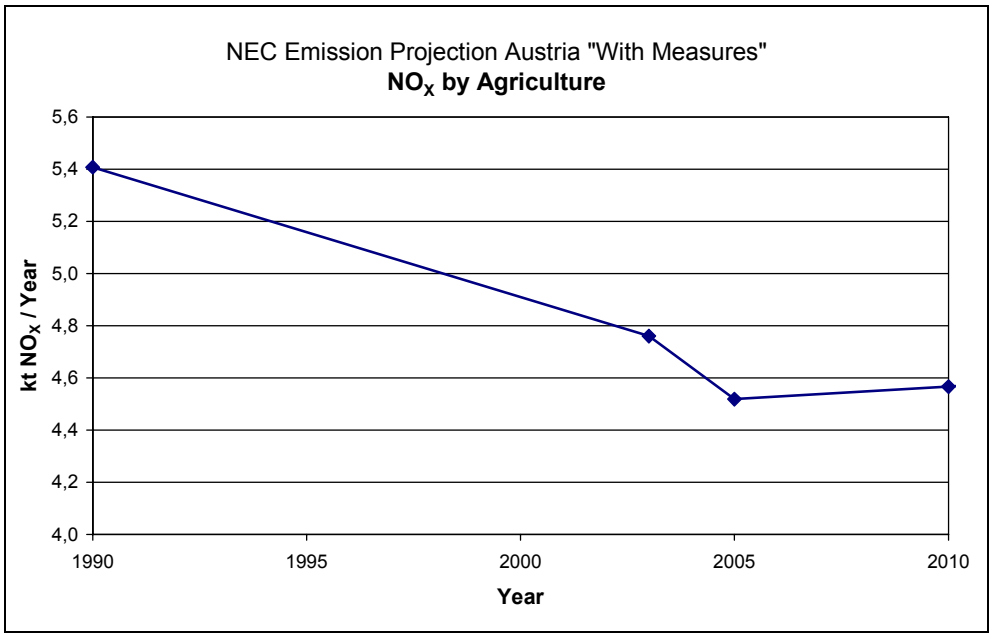
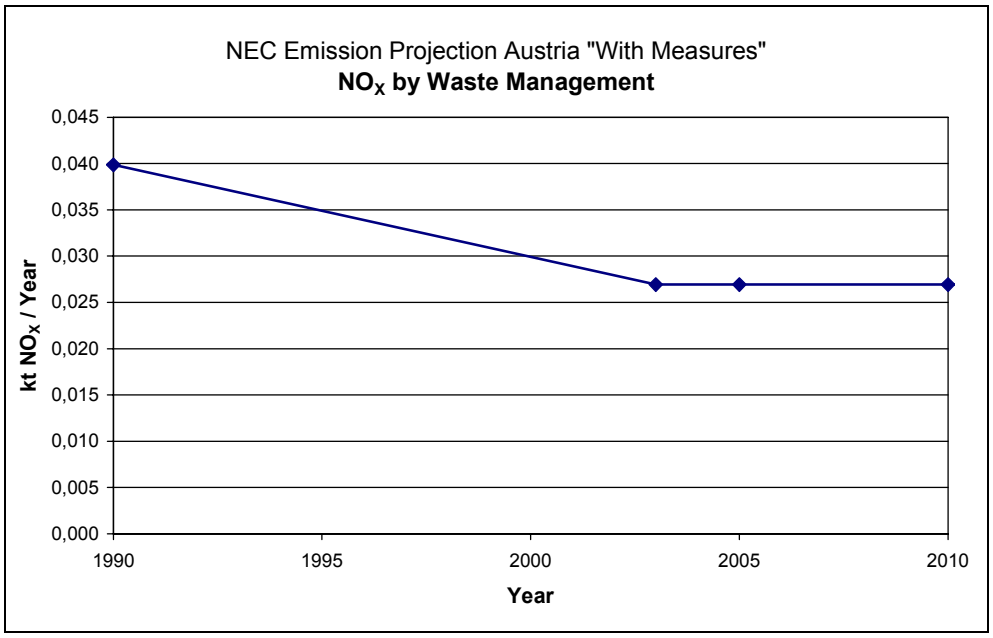


Figure 7: NOx from agriculture, 1990-2010

Figure 8: NOx from waste management, 1990-2010



2.2 Sulphur Dioxide SO_2

SO_2 Emissions show a significant reduction from 1990 to 2000 mainly because of the implementation of emission limits in the power generation sector and the reduction of the sulphur content in mineral oil products. The projections for 2010 based on current legislation (with measures) show a reduction of 13 kt below the emission ceiling of 39 kt.

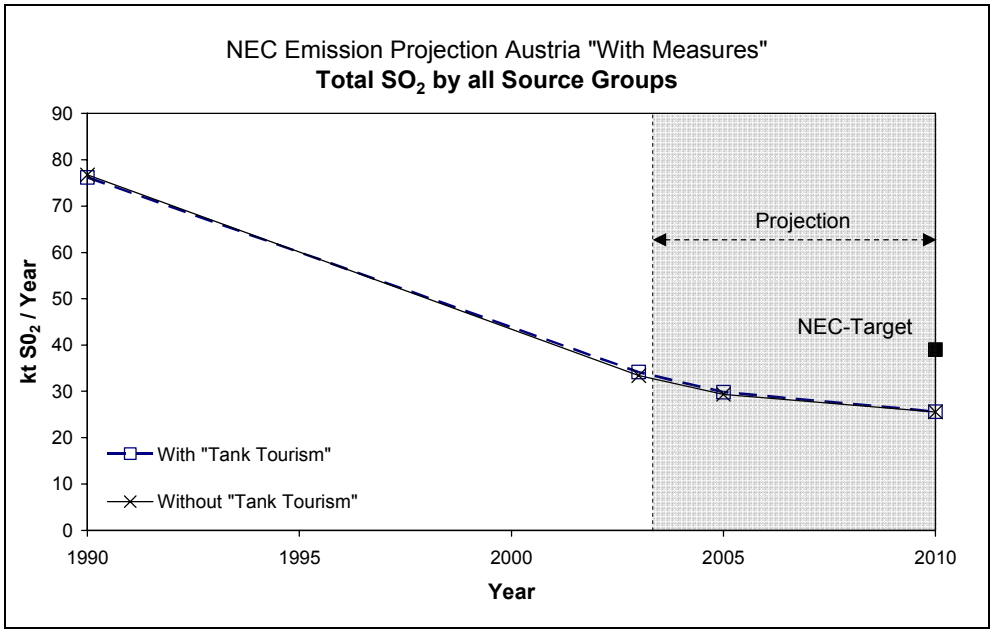


Figure 9: Historical and projected emissions of SO_2 in comparison to the national emissions ceiling.

One of the main reasons for projected further reductions of SO_2 emissions until 2010 is changes in the share of different fuel types. A significant decline in the use of coal is expected in the power plants and household sectors, respectively. This will also be acompanied by a decline of fossil liquid fuel use. In the traffic sector, the main driver for the downward trend is the reduction of the sulphur content in diesel products.

Table 4: Austria's SO_2 emission projection for 2005 and 2010

NEC GAS SOURCE CATEGORIES		SO_2 [kt]			
		1990	2003	2005	2010
	National Total with "Tank Tourism"	**76,18**	**34,14**	**29,84**	**25,62**
	National Total without "Tank Tourism"	*76,77*	*33,38*	*29,35*	*25,58*
1 A 1, 1 B	**Energy Industries and Fugitive Emissions**	**16,00**	**8,58**	**8,00**	**6,85**
1 A 1	Energy Industries	14,00	8,43	7,87	6,70
1 B 1	Solid fuels	NA	NA	NA	NA
1 B 2	Oil and natural gas	2,00	0,15	0,13	0,14
1 A 2	**Manufacturing Industries and Construction**	**18,23**	**11,90**	**10,21**	**9,70**
1 A 2	Manufacturing Industries and Construction	18,23	11,90	10,21	9,70
1 A 3	**Transport**	**4,07**	**2,24**	**1,57**	**0,28**
1 A 3	Transport	4,07	2,24	1,57	0,28
1 A 4, 1 A 5	**Buildings and Other**	**35,59**	**10,15**	**8,91**	**7,44**
1 A 4 a	Commercial/Institutional	5,00	1,05	0,86	0,63
1 A 4 b	Residential	27,89	8,32	7,50	6,32
1 A 4 c	Agriculture/Forestry/Fisheries	2,69	0,77	0,50	0,47
1 A 5	Other	0,01	0,01	0,04	0,02
2, 3	**Industrial Processes with Solvent and Other Product Use**	**2,22**	**1,21**	**1,09**	**1,30**
2 A	Mineral Products	NA	NA	NA	NA
2 B	Chemical Industry	1,56	0,77	0,59	0,78
2 C	Metal Production	0,66	0,45	0,50	0,51
2 D	Other Production	NA	NA	NA	NA
2 G	Other	NA	NA	NA	NA
3	Solvent and other Product Use	NA	NA	0,00	0,00
4	**Agriculture**	**0,00**	**0,00**	**0,00**	**0,00**
4 B	Manure Management	NA	NA	NA	NA
4 C	Rice Cultivation	NO	NO	NO	NO
4 D	Agricultural Soils	NA	NA	NA	NA
4 F	Field Burning of Agricultural Residues	0,00	0,00	0,00	0,00
4 G	Other	NO	NO	0,00	0,00
6	**Waste Management**	**0,06**	**0,05**	**0,05**	**0,05**
6 A	Solid Waste Disposal on Land	NA	NA	NA	NA
6 B	Wastewater Handling	NA	NA	NA	NA
6 C	Waste Incineration	0,06	0,05	0,05	0,05
6 D	Other Waste	NA	NA	NA	NA
I B Av	International Bunkers (Aviation)	0,28	0,46	0,58	0,69
I B Mar	International Bunkers (Marine)	NO	NO	NO	NO

IE … included elsewhere; NA… not applicable; NO … not occurring

Sectoral emission projection of sulphor dioxide

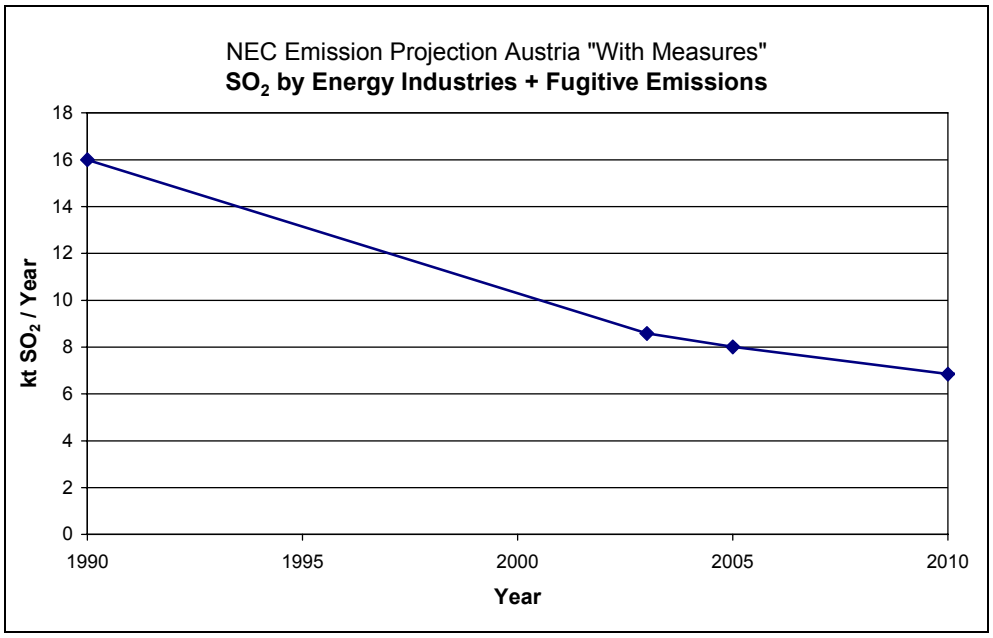


Figure 10: SO_2 from energy industries and fugitive emissions, 1990-2010

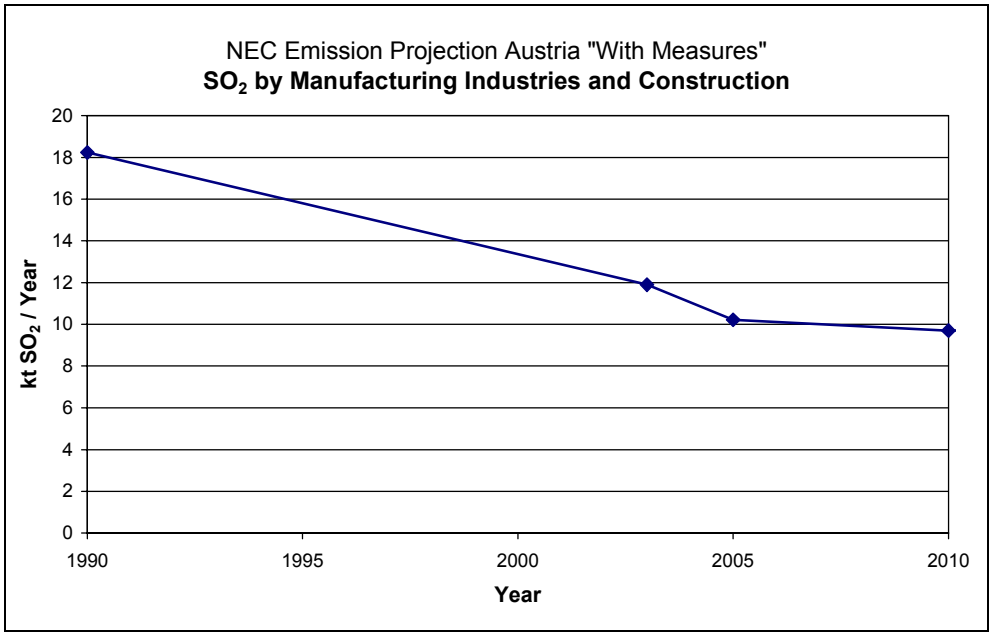


Figure 11: SO_2 from manufacturing industries and construction, 1990-2010

Figure 12: SO_2 from transport, 1990-2010

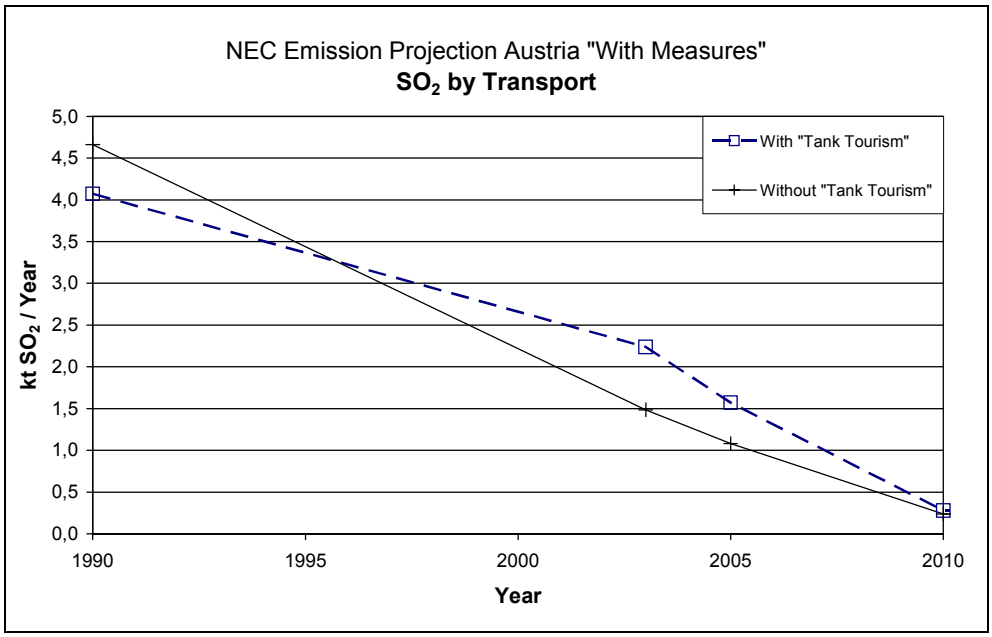
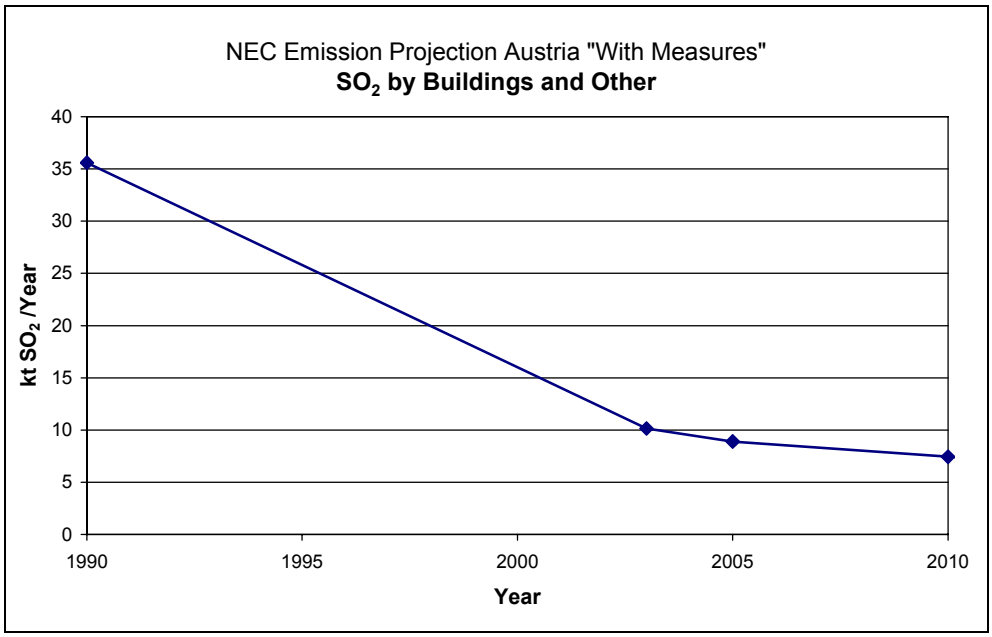


Figure 13: SO_2 from buildings and other, 1990-2010



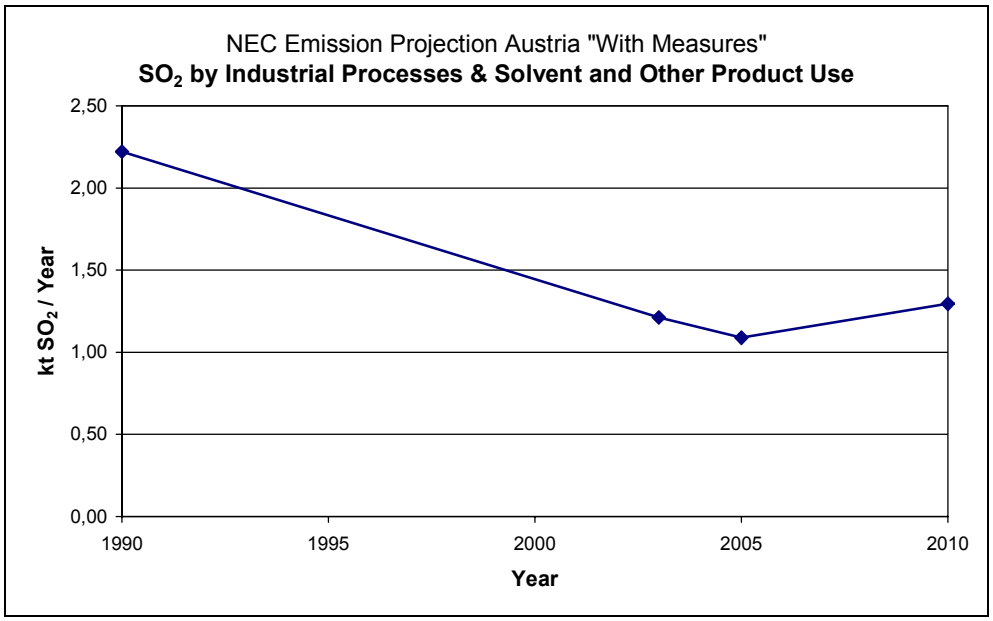


Figure 14: SO_2 from industrial processes and solvent and other product use, 1990-2010

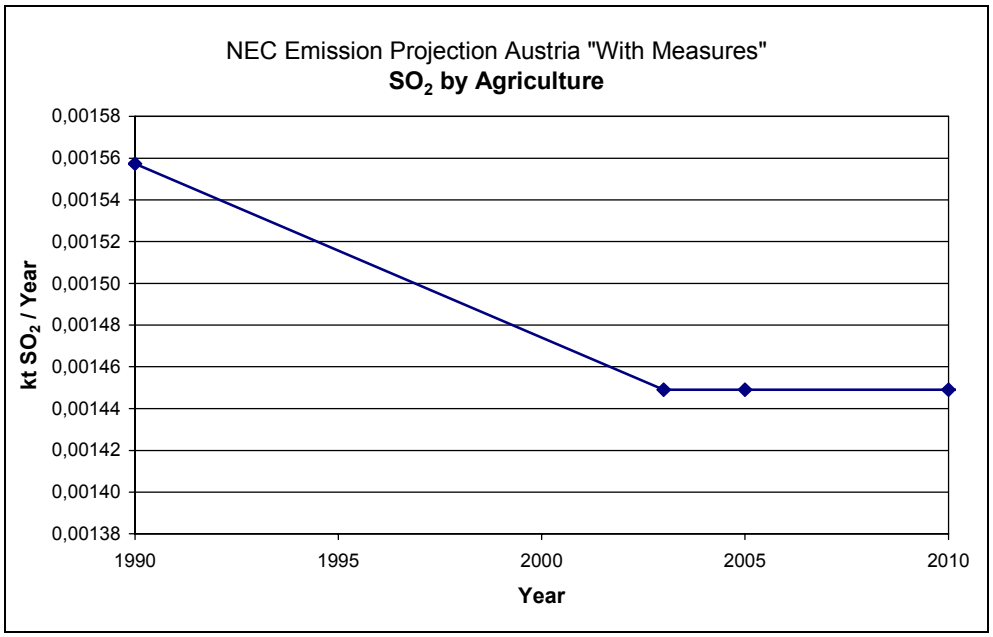
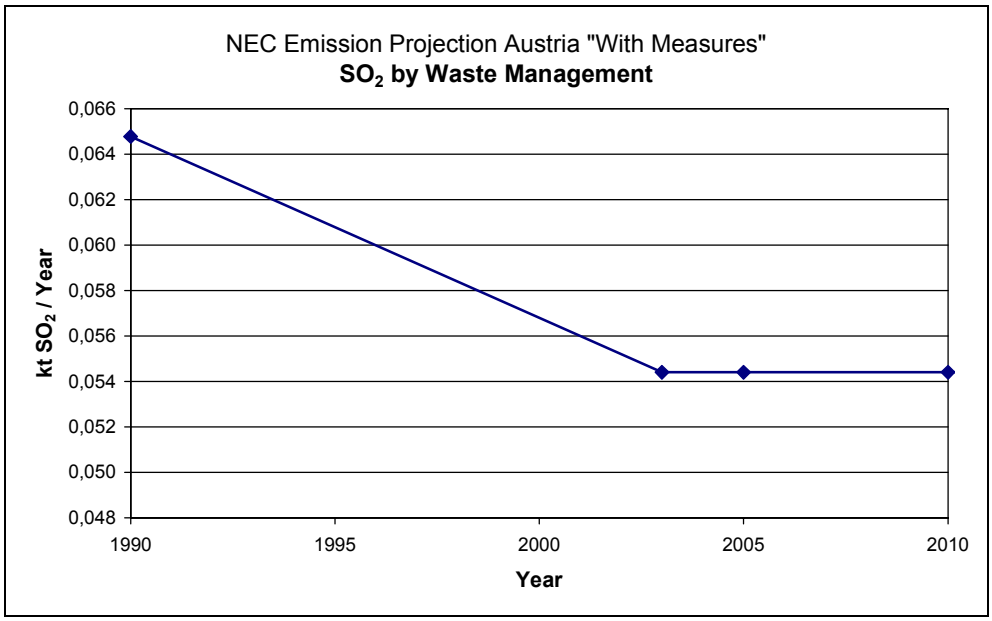


Figure 15: SO_2 from agriculture, 1990-2010

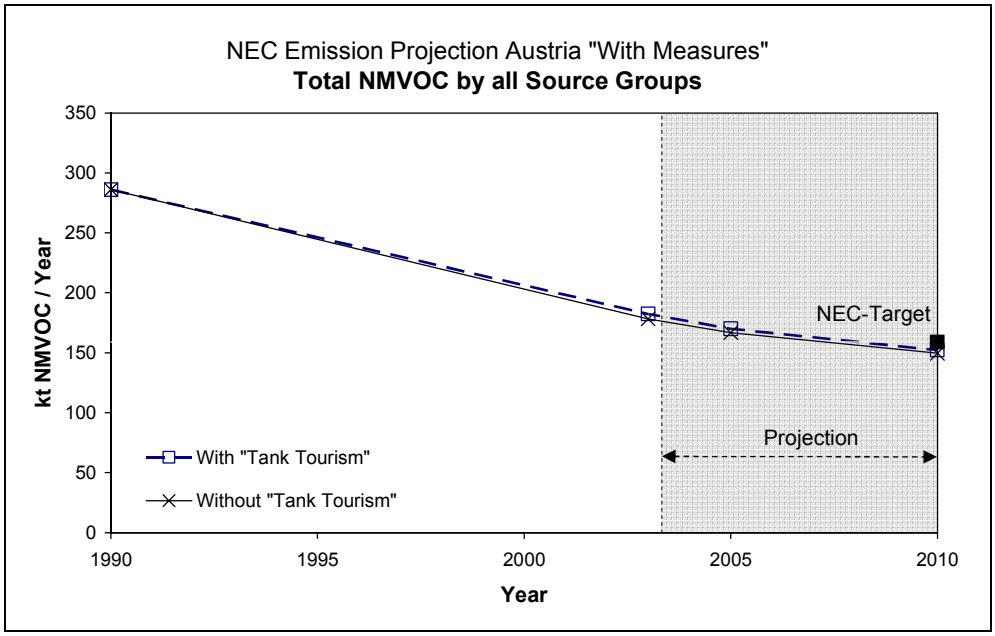
Figure 16: SO_2 from waste management, 1990-2010



2.3 Non-Methane Volatile Organic Compounds (NMVOCs)

The emissions of non-methane volatile compounds show a considerable reduction from 1990 to 2000. The main sources of NMVOC emissions in Austria are fuel combustion activities and solvent and other product use.

Figure 17: Historical and projected emissions of NMVOC in comparison to the national emission ceiling.



A significant part of the reduction is due to regulations for mobile sources and for solvent use. The projections for 2010 show a reduction of 9 kt below the emission ceiling of 159 kt.

Table 5: Austria's NMVOC emission projection for 2005 and 2010

NEC GAS SOURCE CATEGORIES		NMVOC [kt]			
		1990	2003	2005	2010
	National Total with "Tank Tourism"	**286,02**	**182,30**	**170,02**	**152,18**
	National Total without "Tank Tourism"	*286,11*	*178,28*	*166,75*	*149,57*
1 A 1, 1 B	**Energy Industries and Fugitive Emissions**	**12,97**	**4,19**	**3,28**	**3,00**
1 A 1	Energy Industries	0,75	0,74	0,74	0,74
1 B 1	Solid fuels	NA	NA	NA	NA
1 B 2	Oil and natural gas	12,22	3,45	2,55	2,27
1 A 2	**Manufacturing Industries and Construction**	**4,25**	**3,69**	**3,53**	**2,98**
1 A 2	Manufacturing Industries and Construction	4,25	3,69	3,53	2,98
1 A 3	**Transport**	**70,14**	**23,64**	**20,14**	**14,32**
1 A 3	Transport	70,14	23,64	20,14	14,32
1 A 4, 1 A 5	**Buildings and Other**	**68,56**	**50,56**	**44,60**	**37,45**
1 A 4 a	Commercial/Institutional	0,72	1,41	1,25	1,13
1 A 4 b	Residential	58,67	39,72	35,43	30,15
1 A 4 c	Agriculture/Forestry/Fisheries	9,15	9,42	7,91	6,14
1 A 5	Other	0,02	0,01	0,02	0,02
2, 3	**Industrial Processes with Solvent and Other Product Use**	**128,05**	**98,34**	**96,74**	**92,74**
2 A	Mineral Products	IE	IE	IE	IE
2 B	Chemical Industry	8,29	12,34	12,34	12,34
2 C	Metal Production	0,52	0,41	0,41	0,41
2 D	Other Production	2,29	2,96	2,96	2,96
2 G	Other	NA	NA	NA	NA
3	Solvent and other Product Use	116,95	82,63	81,03	77,03
4	**Agriculture**	**1,85**	**1,76**	**1,60**	**1,59**
4 B	Manure Management	NA	NA	NA	NA
4 C	Rice Cultivation	NO	NO	NO	NO
4 D	Agricultural Soils	1,72	1,63	1,48	1,46
4 F	Field Burning of Agricultural Residues	0,13	0,13	0,13	0,13
4 G	Other	NO	NO	NO	NO
6	**Waste Management**	**0,19**	**0,13**	**0,12**	**0,10**
6 A	Solid Waste Disposal on Land	0,18	0,13	0,12	0,10
6 B	Wastewater Handling	NA	NA	NA	NA
6 C	Waste Incineration	0,01	0,00	0,00	0,00
6 D	Other Waste	NA	NA	NA	NA
I B Av	International Bunkers (Aviation)	0,31	0,61	0,76	0,91
I B Mar	International Bunkers (Marine)	NO	NO	0,00	0,00

IE … included elsewhere; NA… not applicable; NO … not occurring

Sectoral emission projection of non-methane volatile organic compounds

Figure 18: NMVOC from energy industries and fugitive emissions, 1990-2010

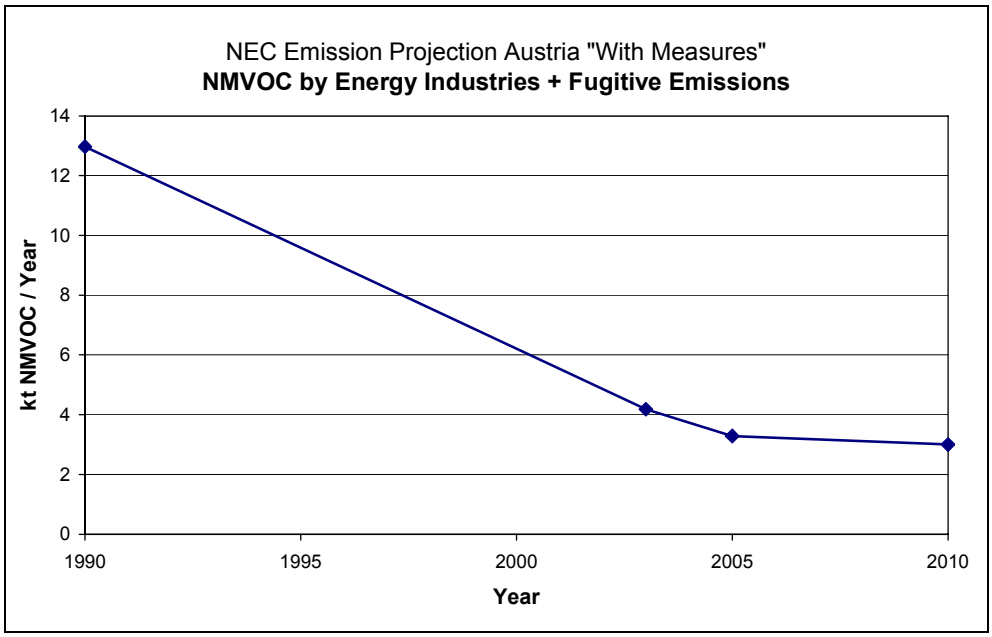
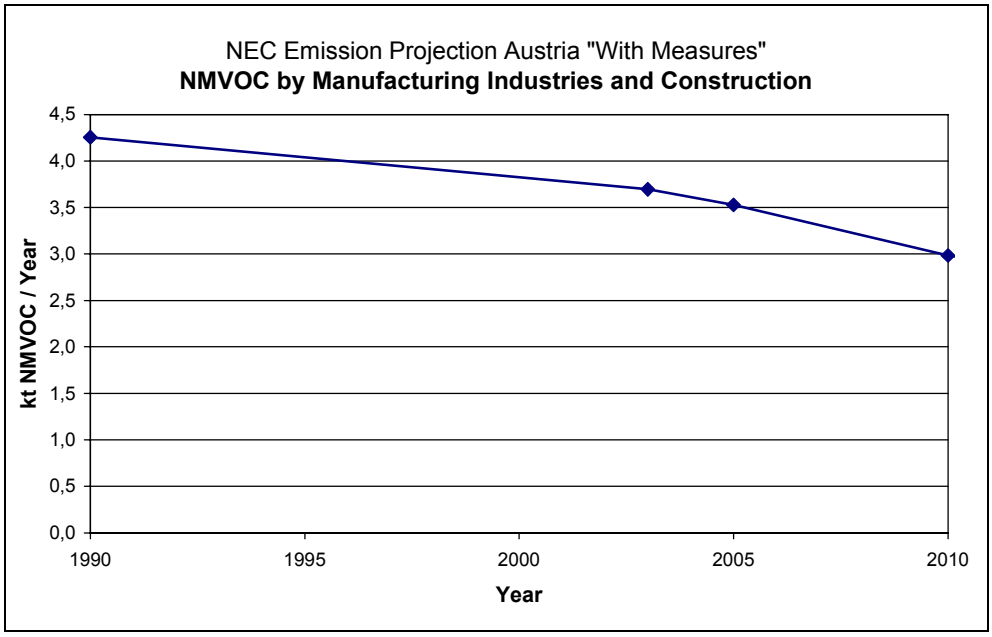


Figure 19: NMVOC from manufacturing industries and construction, 1990-2010



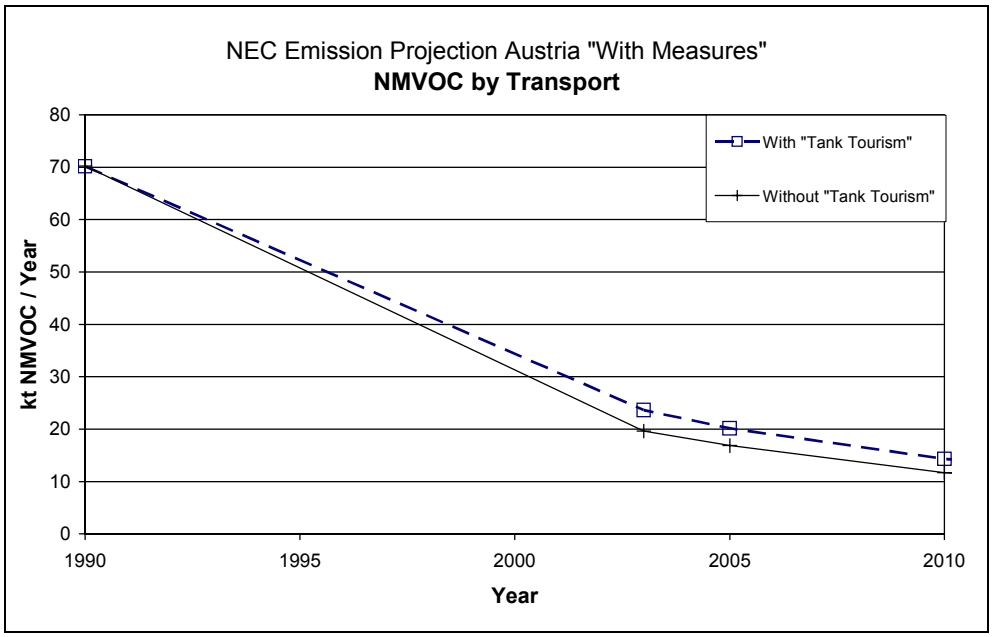


Figure 20: NMVOC from transport, 1990-2010

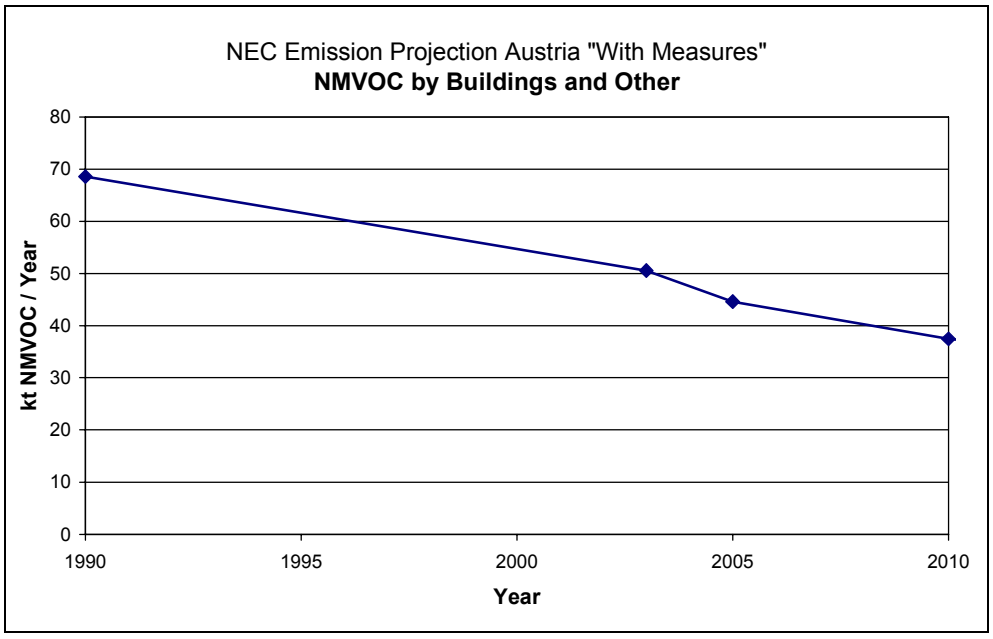


Figure 21: NMVOC from buildings and other, 1990-2010

Figure 22: NMVOC from industrial processes and solvent and other product use, 1990-2010

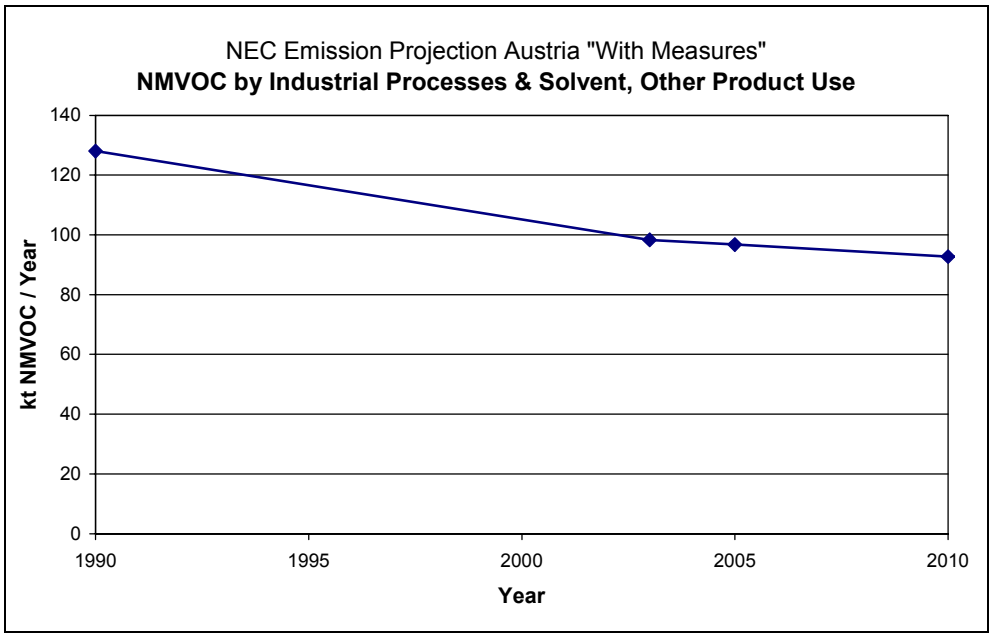
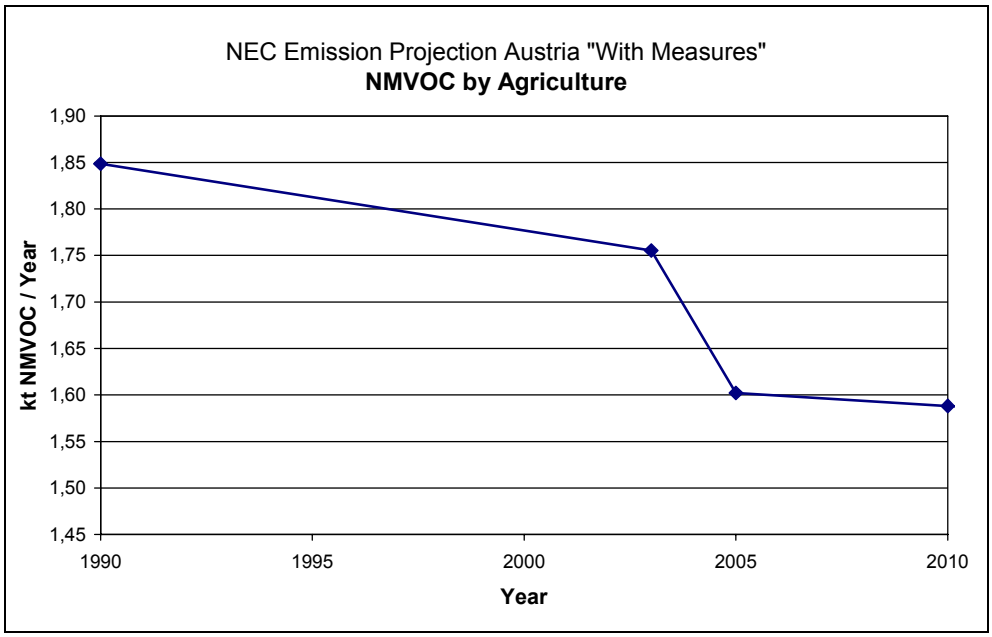


Figure 23: NMVOC from agriculture, 1990-2010



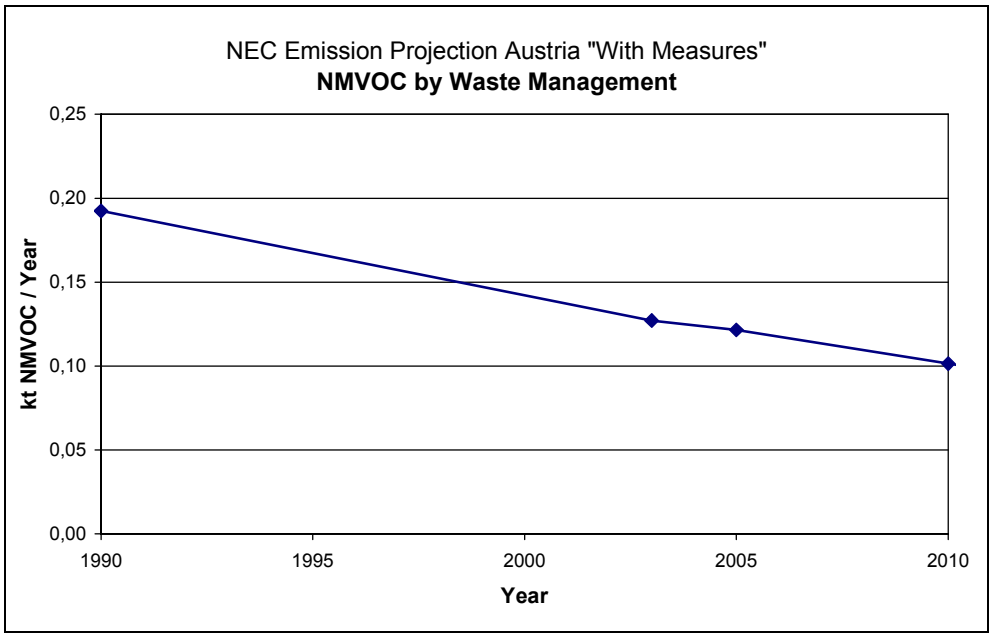


Figure 24: NMVOC from waste management, 1990-2010

2.4 Ammonia (NH_3)

The emissions of NH_3 have slightly decreased since 1990. The main source for ammonia is the agricultural sector contributing more than 95 % of total NH_3 emissions. The projections for 2010 show a further decrease of emissions and a reduction of 13 kt below the national emission ceiling.

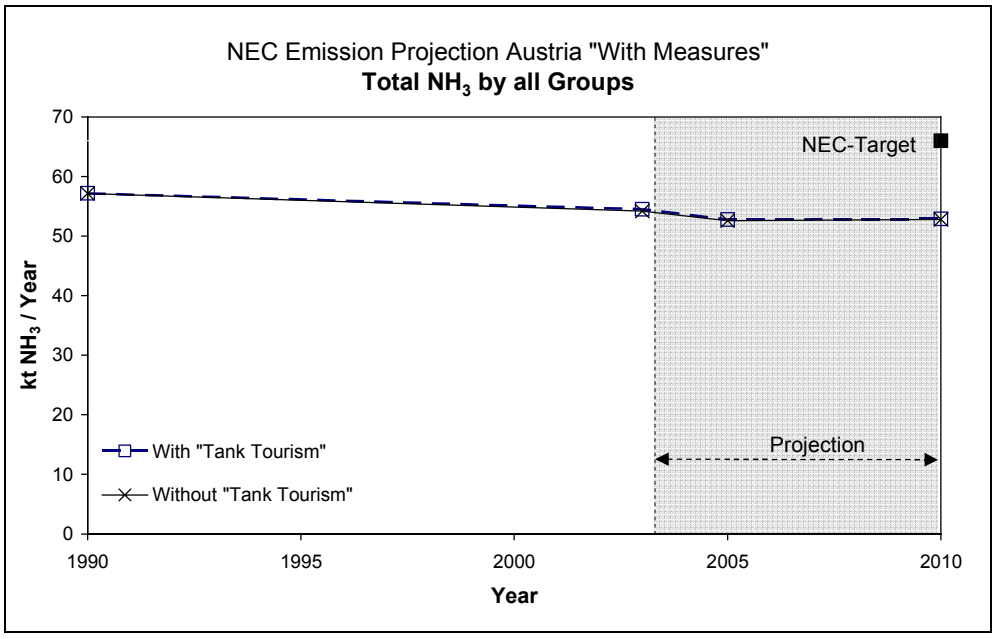


Figure 25: Historical and projected emissions of NH_3 in comparison to the national emissions ceiling.

The trend follows Austrian livestock numbers and the reduction in housing systems of diary cattle.

Table 6: Austria's NH_3 emission projection for 2005 and 2010

NEC GAS SOURCE CATEGORIES		NH_3 [kt]			
		1990	2003	2005	2010
	National Total with "Tank Tourism"	**57,15**	**54,49**	**52,78**	**52,89**
	National Total without "Tank Tourism"	*57,15*	*54,18*	*52,58*	*52,79*
1 A 1, 1 B	**Energy Industries and Fugitive Emissions**	**0,20**	**0,30**	**0,31**	**0,32**
1 A 1	Energy Industries	0,20	0,30	0,31	0,32
1 B 1	Solid fuels	NA	NA	NA	NA
1 B 2	Oil and natural gas	IE	IE	IE	IE
1 A 2	**Manufacturing Industries and Construction**	**0,22**	**0,28**	**0,29**	**0,31**
1 A 2	Manufacturing Industries and Construction	0,22	0,28	0,29	0,31
1 A 3	**Transport**	**0,98**	**1,41**	**1,07**	**0,52**
1 A 3	Transport	0,98	1,41	1,07	0,52
1 A 4, 1 A 5	**Buildings and Other**	**0,63**	**0,75**	**0,75**	**0,74**
1 A 4 a	Commercial/Institutional	0,07	0,06	0,07	0,06
1 A 4 b	Residential	0,51	0,65	0,64	0,63
1 A 4 c	Agriculture/Forestry/Fisheries	0,05	0,05	0,04	0,04
1 A 5	Other	0,00	0,00	0,00	0,00
2, 3	**Industrial Processes with Solvent and Other Product Use**	**0,27**	**0,08**	**0,07**	**0,07**
2 A	Mineral Products	NA	NA	0,00	0,00
2 B	Chemical Industry	0,27	0,07	0,07	0,07
2 C	Metal Production	IE	IE	0,00	0,00
2 D	Other Production	NA	NA	0,00	0,00
2 G	Other	0,00	0,00	0,00	0,00
3	Solvent and other Product Use	NA	NA	0,00	0,00
4	**Agriculture**	**54,47**	**50,95**	**49,42**	**50,04**
4 B	Manure Management	46,34	43,09	41,14	41,58
4 C	Rice Cultivation	NO	NO	NO	NO
4 D	Agricultural Soils	8,08	7,82	8,24	8,42
4 F	Field Burning of Agricultural Residues	0,05	0,04	0,04	0,04
4 G	Other	NO	NO	NO	NO
6	**Waste Management**	**0,38**	**0,72**	**0,87**	**0,89**
6 A	Solid Waste Disposal on Land	0,01	0,00	0,00	0,00
6 B	Wastewater Handling	NA	NA	NA	NA
6 C	Waste Incineration	0,00	0,00	0,00	0,00
6 D	Other Waste	0,37	0,72	0,87	0,89
I B Av	International Bunkers (Aviation)	0,00	0,00	0,00	0,00
I B Mar	International Bunkers (Marine)	NO	NO	0,00	0,00

IE … included elsewhere; NA… not applicable; NO … not occurring

Sectoral emission projection of ammonia

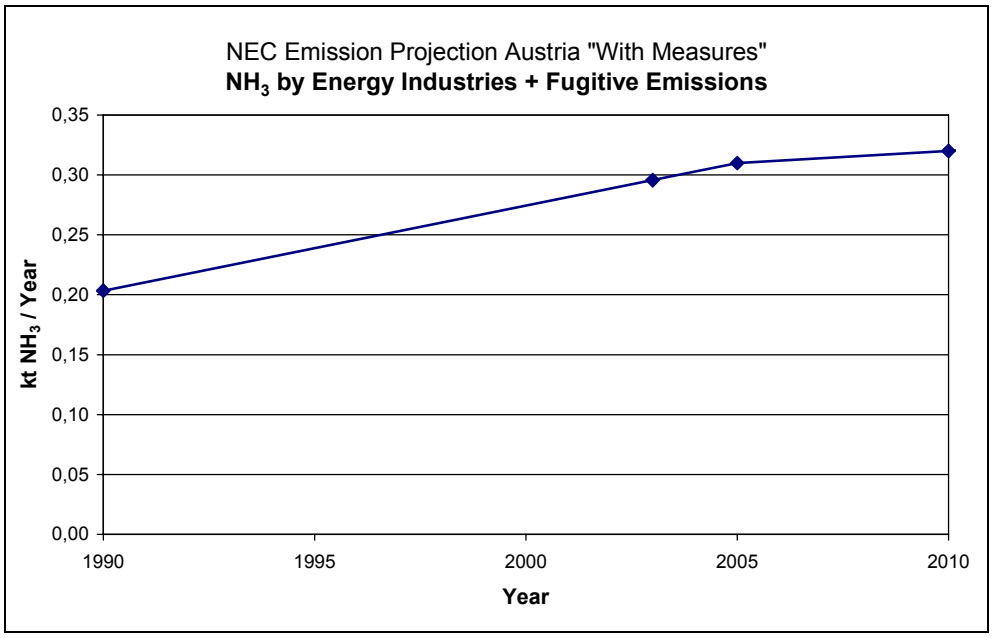


Figure 26: NMVOC from energy industries and fugitive emissions, 1990-2010

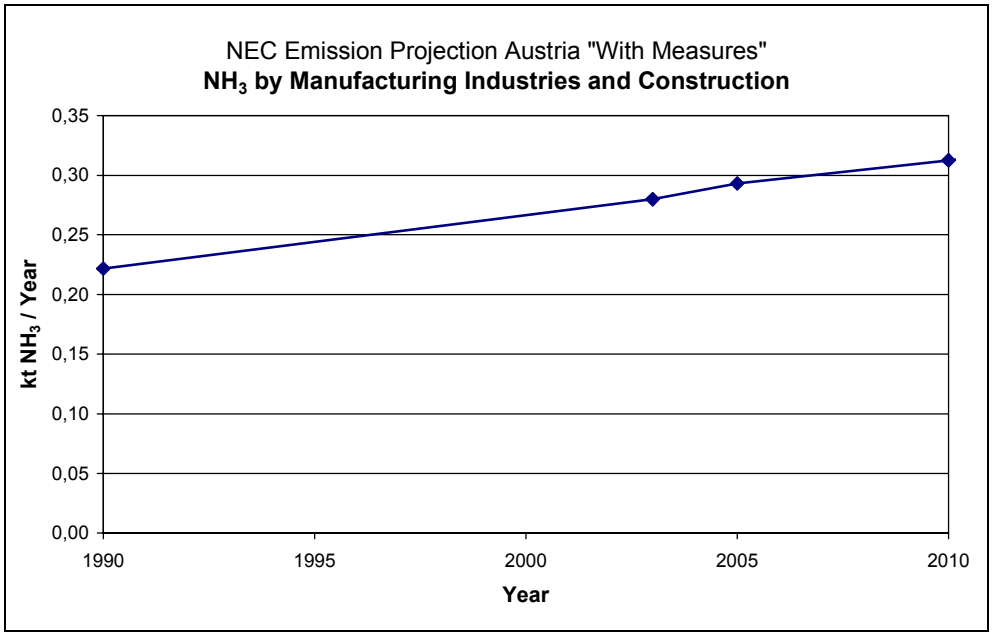


Figure 27: NH_3 from manufacturing industries and construction, 1990-2010

Figure 28: NH_3 from transport, 1990-2010

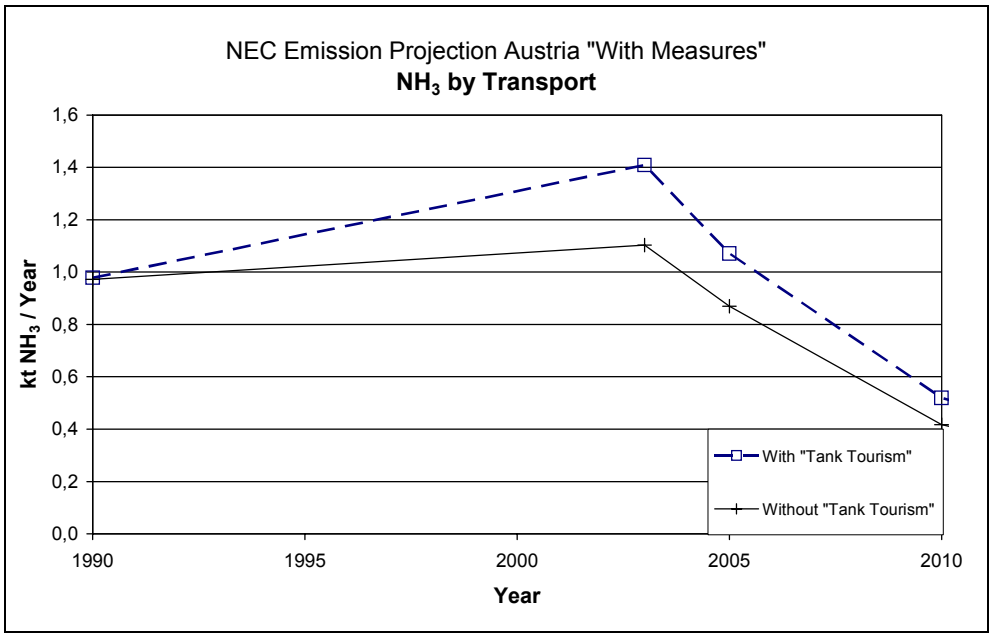
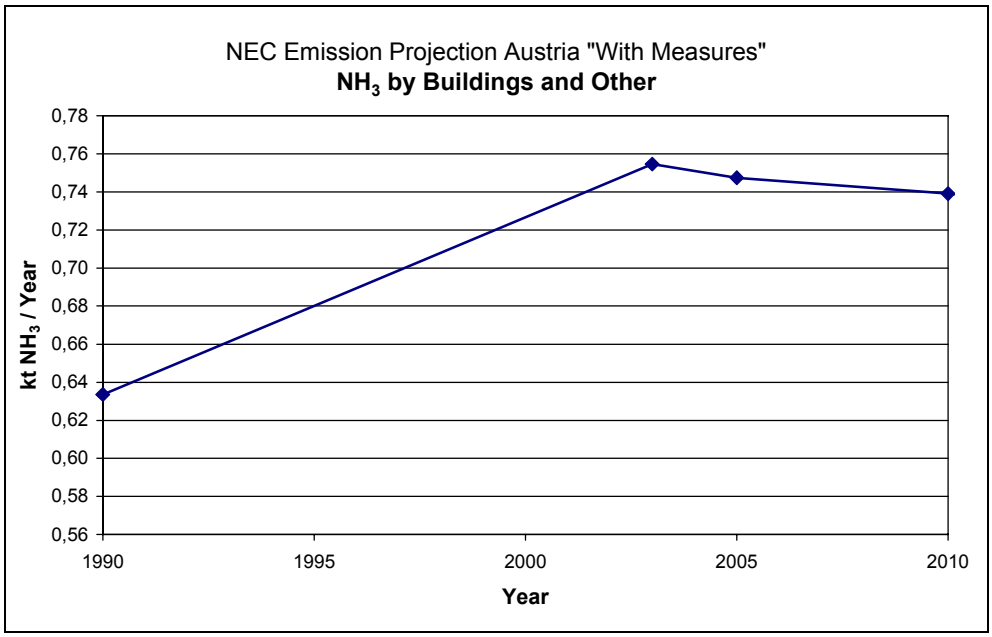


Figure 29: NH_3 from buildings and other, 1990-2010



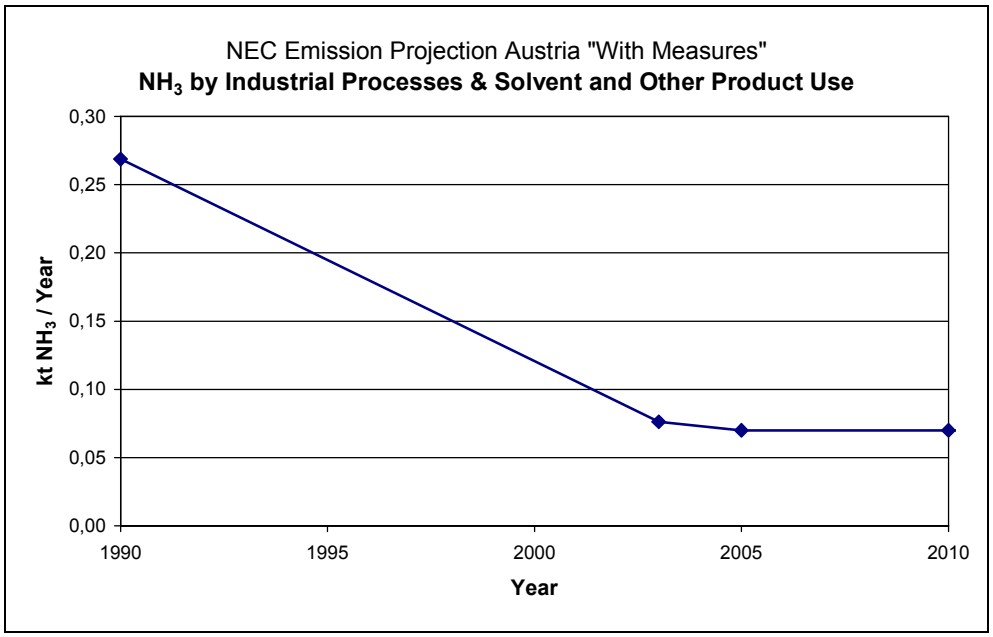


Figure 30: NH_3 from industrial processes and solvent and other product use, 1990-2010

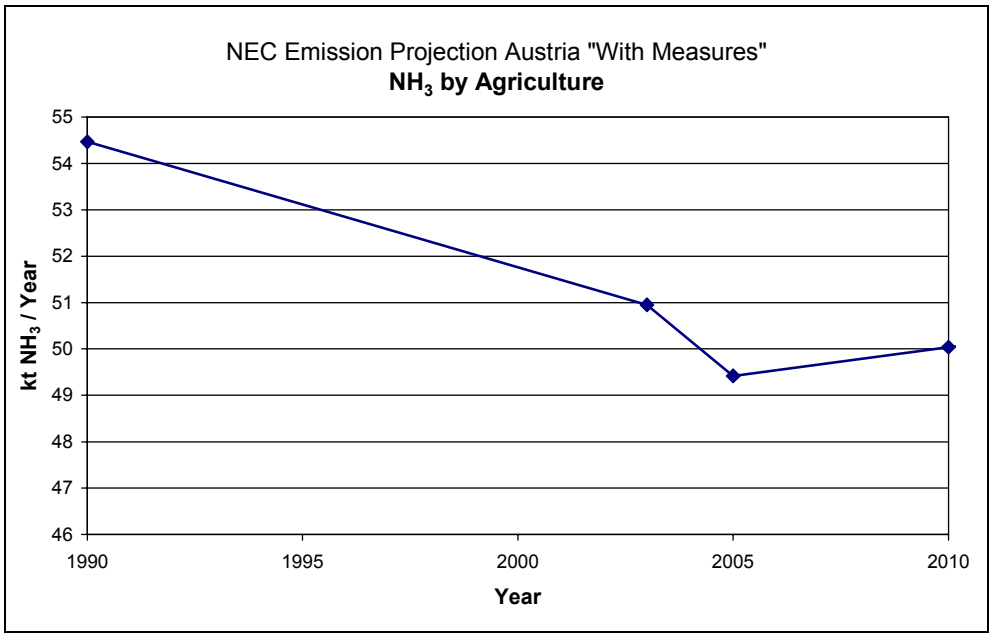
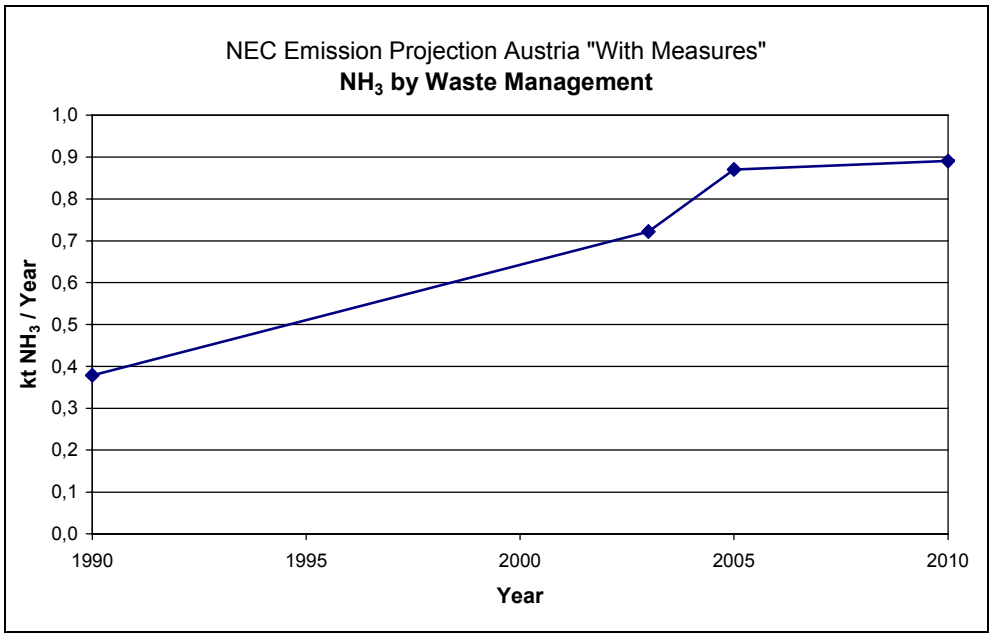


Figure 31: NH_3 from agriculture, 1990-2010

Figure 32: NH_3 from waste management, 1990-2010



3 METHODOLOGY

3.1 General Approach

Generally, the projections were designed to be consistent with the Austrian Inventory in the projection base year 2003. Where reasonable and applicable, the emissions were calculated and projected on the basis of the methodology of the Austrian Inventory. The results for each gas are listed in the NFR (Nomenclature For Reporting) code. Seven aggregated projection source groups were defined as listed below.

	Projection Source Group	**NFR**
I	Energy Industries + Fugitive Emissions	1.A.1 und 1.B
II	Manufacturing Industries and Construction	1.A.2
III	Transport	1.A.3
IV	Buildings and Other	1.A.4 und 1.A.5
V	Industrial Processes with Solvent and Other Product Use	2 und 3
VI	Agriculture	4
VII	Waste Management	6

For all sectors reduction measures were identified and emissions were projected by specifically designed models. The methodology used for the projections of the key driving forces and emissions calculation is described in detail in the respective chapters. Consistency between sector models was ensured by regular expert meetings which addressed overlaps and possible gaps.

In this report all implemented measures between 1.1.1995 and 25.1.2005 are considered for the "with measures" scenario. Emissions from energy related sectors (NFR 1.A) are calculated on the basis of an energy projection established in September 2005 [1].

3.2 Projections of key input parameters for emissions calculation

The general socio-economic assumptions data which form the basis of the Austrian emission projection can be found in table 7. An additional annual 3.2 % growth of the production of real assets (base year 2000) is assumed from 2004 to 2010. Further assumptions of key input parameters can be found in Tables 20 and 21.

Table 7: Key input parameter of emission projections

Year	Economic Growth (GDP, base year 2000)	Population	Stock of Flats	Oil price, "Brent", base year 2000	Exchange rate
	[%, real]	[mio]	[mio]	[US$ per bbl, real]	[US$ per €]
2004	1,9	8,105	3,727		1,24
2005	2,2	8,131	3,740	35,0	1,34
2006	2,3	8,158	3,751	32,5	1,28
2007	2,2	8,184	3,762	30,0	1,22
2008	2,2	8,209	3,775	32,5	1,18
2009	2,2	8,233	3,789	34,0	1,15
2010	2,2	8,255	3,807	35,5	1,15

Model calculations are based on custom-made methodologies for the individual sectors. Emissions from the energy related sectors SNAP[3] 01-03 and industrial processes SNAP 04 are based on a macro-economic model and on an energy model of the Austrian Institute for Economic Research [1]. Projections for solvent use (SNAP 06) have been modelled on the basis of recent studies carried out by the Institut für Industrielle Ökologie und Forschungsinstitut für Energie- und Umweltplanung Wirtschafts- und Marktanalysen Ges.m.b.H. [2, 3].

Projections for Transport (SNAP 07 and 08) have been modelled by the Technical University of Graz [4]. Projections for the sector agriculture (SNAP 10) have been calculated by BAL Gumpenstein [5, 6] and the Austrian Institute for Economic Research (WIFO) [1] in cooperation with Umweltbundesamt.

The following table presents the main data sources used for activity data as well as information on who contributed to the calculations:

Table 8: Main data sources for activity data and emission values

Sector	Data Sources for Activity Data	Emission Calculation
Energy	Austrian Institute for Economic Research (macroeconomic model MULTIMAC, energy model DAEDALUS) Graz University of Technology (transport model GLOBEMI)	UMWELTBUNDESAMT (energy providers and manufacturing industries) Austrian Energy Agency – EVA (residential and commercial sector) Graz University of Technology (transport sector)
Industry	Austrian Institute for Economic Research (macroeconomic model MULTIMAC)	UMWELTBUNDESAMT
Waste	Landfill database and projection on solid waste to landfill	UMWELTBUNDESAMT
Solvent	Forschungsinstitut für Energie und Umweltplanung, Wirtschaft und Marktanalysen GmbH and Institut für industrielle Ökologie (bottom-up model)	Forschungsinstitut für Energie und Umweltplanung, Wirtschaft und Marktanalysen GmbH and Institut für industrielle Ökologie
Agriculture	Animal number, fertilizer use, crop- and grassland: Austrian Institute for Economic Research (agriculture model PASMA) Animal waste management system distribution 2005-2020: Federal Research Institute for Agriculture in Alpine Regions [6] (spreadsheet model)	UMWELTBUNDESAMT

[3] SNAP: Selected Nomenclature for sources of Air Pollution

3.2.1 Energy Projections

The energy model has been developed by the Austrian Institute of Economic Research ("Wirtschaftsforschungsinstitut", WIFO). It is an extension of the model system that was used for previous energy projections, for example those com-missioned in 2001 by the Federal Ministry of Economics and Labour and the Fed-eral Ministry of Agriculture, Forestry, Environment and Water Management (WIFO 2001), see [7], and for Austria's Third National Communication to the UNFCCC. The model is a macroeconomic energy and environment model; the energy system and the economy are integrated into one disaggregated model. Almost all parameters are based on econometric estimates with time series for Austria. It uses the format of the energy balances of the International Energy Agency, i. e. about 40 energy sources and about 70 categories of energy demand and supply. The economy is disaggregated into 31 sectors, taking into account the NACE sector definitions.

The energy scenarios have been calculated by the Institute of Economic Research as part of a contract with the Federal Ministry of Agriculture, Forestry, Environment and Water Management. These calculations are based on a WIFO report about energy scenarios for Austria up to 2020 [8] that was commissioned by the Federal Ministry of Economics and Labour in 2005. The "With Measures" energy scenario used for the emission projection is closely related to the "Baseline" scenario of this report.

3.2.2 Industrial Processes

The development of industrial production was forecast by applying macro-economic data for the sub-sectors [1], taking into account known predictions about expansions (iron and steel production [9]), the opening of new installations (sulphuric acid production [10, 11]) and the decommissioning of old facilities [12, 16].

3.2.3 Transport Projections

The forecast contains two different models:

Road and off-road except aviation:

These sectors have been calculated by the Technical University of Graz using a macroeconomic model, the GLOBEMI model. The same model is also used for the yearly emission inventory. A comprehensive description of the methodology can be found in the Austrian Informative Inventory report [17].

The model considers different input parameters like GDP, mineral oil price and the development of infrastructure.

Aviation:

The projection is an extrapolation of the trend of the latest years. The annual growth rate (of energy) is assumed to be 3.6 % until 2010, from 2010–2020 the assumed rate is approximately 3.4 %.

3.2.4 Agriculture Projections

Emissions are calculated on the basis of the methodology used for the Austrian inventory [17].

The required input parameters were estimated by means of a spreadsheet model (animal waste management system distribution data [6]) and the agricultural sector model PASMA. PASMA (developed by WIFO) was employed to estimate livestock population, the use of mineral fertilizers and the development of cropland and grassland. The model is based on the method of positive mathematical programming (PMP). This approach is a mathematical non-linear projection model which allows flexible adaptations to new conditions.

Scenario assumptions, animal waste management system distribution and the results of the PASMA model were supported by the following agricultural experts:

Policy measures:

- DI Elmar Ritzinger, BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Abteilung II/9: Investitionen und Marktstruktur
- DI Sonja Schantl, BM für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Referat III/9b
- DI Rupert Lindner, Landwirtschaftskammer Österreich, Referat III/1, Pflanzliche Erzeugnisse

Livestock projections, milk yield and animal waste management systems:

- DI Alfred Pöllinger et al., Federal Research Institute for Agriculture in Alpine Regions, A-8952 Irdning [5, 6].

The following policy measures are considered for implementation ("with measures" scenario):

- implementation of the CAP 2003 reform; special attention is given to the Austrian variant of implementation (keeping the premiums for suckler cows – including heifers – and part of the slaughter premiums; allocation of premium rights to farmers);
- due to uncertainties concerning the flow of funds from "modulation", we assumed that the amount that Austrian farmers who might be beneficiaries receive is the same as the one that other farms lose through this measure;
- land is maintained in good agricultural and ecological condition ("cross compliance";
- the programme for rural development is retained unchanged.

Overview of the PASMA scenario results "with measures"

Livestock

- the number of livestock – in particular cattle – will get smaller because of reduced production incentives (premiums per head will be decoupled for bulls);
- the number of suckler cows will be less affected because premiums per head will be coupled to production even after the reform in Austria; a given share of heifers qualifies for such premiums as well, therefore the number of suckler cows and heifers will be relatively constant;

- since farmers will get coupled premiums either for suckler cows or heifers but other premiums for cattle will be abandoned, the population of suckler cows will not necessarily increase – the reason being that the model takes account of the profitability of the whole cattle production simultaneously – and an implication here is that the value of calves will drop;
- our results suggest that the additional premiums for Austria will amount to a windfall for farmers producing heifers already (assuming that the market for suckler cow premium entitlements is working efficiently)
- the consequence of lower prices for pork and poultry and lower feeding cost is that the output of none of these products will be expanded – this being a consequence of the modelling approach taken in this analysis;
- therefore, less or no supply substitution of beef by other meat is expected;
- due to the model type used for this analysis, the change of pork and poultry production will be "0" under such circumstances.

Milk Yield

The volume of milk production is determined by the national quota which will be expanded in two steps and which will be fixed from 2008 onwards; since some share of milk is used as animal feed, production also depends on its nutritional value relative to the production cost of increasingly productive milk cows; the decline of milk production from 2003 to 2005 was due to the assumption that lower milk prices would induce more farmers to refrain from an "oversupply" of milk above the quota (which effectively means that the super-levy will have economic consequences);

Organic Farming

Organic farming will become more attractive for farmers, mainly because of the assumption that premiums of the agri-environmental programme will stay in place and prices of organic products will be higher while opportunity costs will be lower after the implementation of the reform;

Animal Waste Management Systems (AWMS)

Austrian national statistics on AWMS are not available, and therefore the distribution used was estimated and forcast by national experts (Pöllinger and Ofner from BAL Gumpenstein [6]).

Synthetic Fertilizer Use

An agricultural sector model (PASMA, developed by WIFO) was employed to estimate the use of mineral fertilizers. The model (based on the method of positive mathematical programming) was used to evaluate the reform of the Common Agricultural policy and its development and, for trend scenarios with the implementation of Water Framework Directive [18] in other studies.

In the model, input requirements (and thus fertilizer demands) are evaluated at the nutritional level. The calculations mimic farmer behaviour, which allows for substitution of nutrients purchased on the market (commercial fertilizer) with nutrients accumulated by crops (legumes) and animal waste containing nutrients (manure).

Agricultural Cropland

PASMA is a model which is calibrated using observed conditions during a base period. Therefore the model results are fully consistent with observations from official statistics. In the model, the economic accounts of agriculture [19] are used as a benchmark. Therefore crop allocations in the model are identical with those of official statistics during the base period.

In the forecast period, the model assumes that farmers choose to farm land according to the microeconomics of individual behaviour based on profit maximisation. In the model, all relevant farm policies are accounted for in a very detailed manner. Therefore the model is capable of considering support schemes for organic farming as well. This type of farming uses legumes to accumulate nutrients and the model considers this by incorporating nutrient balances.

Grassland

Grassland and arable land are treated similarly in the model: all relevant activities and policies affecting decisions on land allocation are accounted for. Given the recent reform of the Common Agricultural Policy, one important consequence is that the share of land used for agricultural purposes will be more or less frozen in the decade to come. In the past it was observed that a considerable part of land was afforested. According to the model results this trend will decline because "cross compliance" requirements will force farmers to maintain farm-land in good agricultural condition. A considerable part of the land previously used for arable crops will be converted into grassland, which will expand as a consequence.

3.3 Emission Calculation

3.3.1 General Approach

SNAP 01 – 04

The figures for energy demand in the Austrian economy [1] are split up according to the sub-sectors of the Austrian air emission inventory [17]. As the economic sectors of the energy model do not correspond to the SNAP sectoral structure, fuel consumption had to be assigned to the SNAP sub-sectors. Additionally, data from recent developments e.g. traffic projection and waste projection and deviations from the energy projections have been incorporated.

SNAP 05 - 10

Emissions for the other sectors are calculated on the basis of the methodology of the Austrian inventory. A comprehensive description of the methodologies used for calculating the Austrian Air Emissions Inventory can be found in the Austrian Informative Inventory Report 2004 [17].

3.3.2 Combustion in Energy and Transformation Industries SNAP 01

3.3.2.1 Methodology

SO_2 and NO_X

Emissions for the year 2010 were calculated by multiplying projected energy data [1] by the respective emission factors. The latter were determined for power plants and waste incineration facilities on a plant specific basis for each fuel type taking into account expansions, the commissioning of new plants and the closing down of existing facilities.

A detailed description of the methodologies used can be found in the cited literature [20, 25, 26].

NMVOC and NH_3

NMVOC emissions were considered to remain constant at the level of 2003 [17] because their share in total emissions is <1%.

NH_3 emissions were considered to be proportional to the energy consumption of the related sectors. NH_3 emissions from this sector contribute less than 1% of the total emissions.

3.3.3 Non-Industrial Combustion Plants SNAP 02

3.3.3.1 Methodology

SO_2, NO_X [27] and NMVOC [28]

Commissioned by the Austrian Ministry for Agriculture, Forestry, Environment and Water Management, the Austrian Energy Agency (EVA) conducted a study on projections of NMVOC emissions until 2010 from the household and service sector [28]. An appropriate emission projection model based on spreadsheets was developed which included the following key input parameters:

Final energy demand data of the energy projections [1] were used as activity data for the model.

The emission factors were calculated on the basis of:

- types of heating systems in use: single stoves, self-contained one storey heating systems and central heating
- age of heating systems in use: the systems in use where divided into three groups (boilers older than 20 years, boiler between 20 and 10 years, boilers younger than 10 years)

NH_3

NH_3 emissions were considered to remain constant at the 2002 level [17] because their share in total emissions is 1%.

3.3.4 Combustion in Manufacturing Industry SNAP 03

3.3.4.1 Methodology

SO_2 and NO_X

For the estimation of SO_2 and NO_x SNAP 03 and SNAP 04 were assessed together [21, 24]. The following industrial sectors were identified as major sources:

- production from cement, glass and other mineral industry
- iron and steel production
- pulp and paper production
- process emissions of the chemical industry
- wood processing industry
- food industry
- production of non-ferrous metals
- other sectors of the production industries.

Emission data for the year 2003 was either calculated via reported emissions (cement, iron and steel, pulp and paper) [9, 12, 14] or via energy use (all others). In the first case energy data was used for plausibility checks. In the latter case, energy use was multiplied by sectoral emission factors to calculate emissions. These sectoral emission factors were determined for each sector separately using data from plant specific inquiries. For the pulp and paper industry, specific emission factors were calculated for the different boiler types using the same methodology [15, 16].

Emissions for the year 2010 were calculated by applying the trend of the energy consumption [1] and incorporating recent data from environmental impact statements such as facilty expansions and the opening and closing down of facilities.

NMVOC and NH_3

NMVOC emissions were considered to remain constant at the level of 2003 [17] because their share in the total emissions is <1%.

NH_3 emissions were considered to be proportional to the energy consumption of the related sectors. NH_3 emissions from this sector contribute less than 1% of the total emissions.

3.3.5 Production Processes SNAP 04

3.3.5.1 Methodology

SO_2 and NO_X

The methodology of calculating SO_2 und NO_x is described in Chapter 3.3.4.1.

NMVOC

Because of the implementation of the IPCC Directive (existing installations have to apply BAT by October 2007) a reduction of 3 kt compared to 2002 is expected to be achieved in 2010 [29]. This potential is based on expert judgement.

NH_3

NH_3 emissions were considered to be proportional to the energy consumption of the related sectors. NH_3 emissions from this sector contribute less than 1 % of the total emissions..

3.3.6 Fuels and Geothermal Energy SNAP 05

3.3.6.1 Methodology

SO_2 and NMVOC

SO_2 and NMVOC emission projections from SNAP 05 are based on 2003 emission/activity data ratios and projected activity data such as natural gas and crude oil exploration and natural gas consumption according to [16]. Emission reduction measures such as the introduction of vapour recovery units at depots and service stations were implemented in 2003 already and no further reductions are expected.

A detailed description of the methodology of emission estimation can be found in the Austrian Informative Inventory Report 2004 [17].

NO_x and NH_3

Emissions are not estimated in the Austrian inventory and have therefore not been incorporated in the projections.

3.3.7 Solvent and Other Product Use SNAP 06

3.3.7.1 Methodology

NMVOC

NMVOC emissions of this sector were estimated by means of an in-depth survey on the use and application of solvents and the emission situation in Austria [2]. The investigation was based on an extensive bottom-up survey, performed in selected, most relevant commercial sectors and involving 1300 Austrian companies. With a detailed questionnaire, the specific situation of solvent application in the company and an estimation of future developments (economic development of the company and use of abatement technologies) were obtained, besides some general information. From the responses received, it was possible to derive actual and accurate emission factors at sector level. The estimation of the future developments in the companies allowed the calculation of scenarios on application level for the future in which the expected economic and technical developments played a crucial role. As a second step, a survey in 1800 households was made [3] for estimating domestic solvent use. The use of solvents in the context of undeclared work and do-it-yourself activities was also calculated.

To verify the results from the bottom-up surveys for the base year 2000 the bottom-up approach was combined with top-down data. The top-down approach provided total quantities of solvents used in Austria. The share of the solvents used for the different applications and the solvent emission factors were calculated on the basis of the bottom-up approach. By linking the results of bottom-up and top-down approaches, the quantities of solvents used annually and the solvent emissions for the different applications were obtained.

For the year 2010 the verified data was then projected according to the technical and economic developments which resulted from the questionnaire [2] on SNAP Level 3. The inventory has been updated with data from [3] since the study [2] was published. The proportional ratios of 2010 projections according to [1] to 2000 emissions according to [3] were used to calculate the projections 2010 for each of the 28 subcategories. NMVOC emissions for 2020 were set constant to 2010 emissions because no additional directive or any relevant change in technology is known for the period after 2010.

A comprehensive summary of the methodology for the base year 2000 can also be found in the Austrian Informative Inventory Report [17].

NO_x, SO_2 and NH_3

According to the Austrian inventory there is no occurrence of NO_x, SO_2 and NH_3 emissions from solvent use.

3.3.8 Road Transport and Other Mobile Sources and Machinery SNAP 07 and SNAP 08

3.3.8.1 Methodology

NO_x, SO_2, NMVOC and NH_3

For the estimation of road and off-road emissions (without air-traffic) the GLOBEMI-Model is used for the transport and emissions projections [4]. Emissions are therefore calculated on the basis of the methodology used for the Austrian inventory. A comprehensive description of the methodology can be found in the Austrian Informative Inventory report [17].

The calculation of air-traffic emissions is also based on the calculation for the Austrian Inventory (Austrian best practice). These values are extrapolated with implied emission factors [30] obtained from the Austrian Inventory. According to the current study of the Öko-Institut 2004 [31] further improvements of NOx emission factors are not expected until 2010.

3.3.9 Waste Treatment and Disposal SNAP 09

3.3.9.1 Methodology

NO_x, SO_2, NMVOC and NH_3

Waste Disposal: NMVOC and NH_3 emissions are calculated by keeping the same ratio to CH_4 emissions as for 2003. Projections of CH_4 emissions are calculated by means of projected waste generation rates, an assumed share and degradable carbon content of disposed waste and a share of recovered waste gas.

Waste Incineration: Because of the low contribution to the total emissions (below 1 % for all gases), emission levels from the year 2003 [17] were applied to 2010.

A detailed description of the methodology used for the emission estimation can be found in the Austrian Informative Inventory Report 2004 [17].

3.3.10 Agriculture SNAP 10

3.3.10.1 Methodology

Emissions are calculated on the basis of the methodology used for the Austrian inventory. A comprehensive description can be found in the Austrian Informative Inventory report [17].

Input Parameters for the model have been estimated by BAL Gumpenstein and the Austrian Institute of Economic Research and are listed in Chapter 3.3.10.2. The methodology used for the estimation of input parameters is described in Chapter 3.2.4.

3.3.10.2 Key input parameters

Table 9: livestock population 2000 and projection for 2010

	Population size [heads] * Livestock Category							
Year	Dairy	Non Dairy	Mother Cows (suckling cows >2yr)	Young Cattle <1yr	Young Cattle 1-2yr	Cattle >2yr	Sheep	Goats
2000	621 002	1 534 445	252 792	655 368	466 484	159 801	339 238	56 105
2010	516 057	1 440 076	238 365	611 107	412 769	162 354	334 586	50 104

Table 10: Domestic livestock population 2000 and projection for 2010

	Population size [heads] * Livestock Category							
Year	Horses	Swine	Fattening Pig >50kg	Swine for breeding >50kg	Young Swine <50kg	Poultry	Chicken	Other Poultry
2000	81 566	3 347 931	1 211 988	334 278	1 801 665	11 786 670	11 077 343	709 327
2010	87 072	3 216 235	1 227 143	333 812	1 655 280	13 006 682	12 354 358	652 324

year	Milk yield kg/year	N excretion kg per animal per year
2000	5 210	64,50
2010	6 196	73,00

Table 11: Milk yield and corresponding N excretion rates per cow

Animal Waste Management System (AWMS) distribution

Distribution year 2000: Comprehensive survey [32]

Distribution year 2010: Expert judgement Pöllinger et al. 2004 [6]

Table 12: dairy cows – over year (summer/winter)

Year	Solid Storage [%]	Liquid/Slurry [%]	Pasture/Range/Paddock [%]
2000	70,4	19,0	10,6
2010	50	42,5	7,5

Table 13: mother cows (suckling cows) - over year (summer/winter)

Year	Solid Storage [%]	Liquid/Slurry [%]	Pasture/Range/Paddock [%]
2000	70,4	19,0	10,6
2010	50	0	50

Table 14: cattle 1-2 year – over year (summer/winter)

Year	Solid Storage [%]	Liquid/Slurry [%]	Pasture/Range/Paddock [%]
2000	61,8	12,0	26,2
2010	37,5	37,5	25

Table 15: cattle < 1 year

Year	Solid Storage [%]	Liquid/Slurry [%]
2000	71,3	28,7
2010	70	30

Table 16: cattle > 2 years

Year	Solid Storage [%]	Liquid/Slurry [%]
2000	51,4	48,6
2010	50	50

Table 17: breeding sows

Year	Solid Storage [%]	Liquid/Slurry [%]
2000	30	70
2010	30	70

Table 18: Fattening pigs

Year	Solid Storage [%]	Liquid/Slurry [%]
2000	28,1	71,9
2010	20	80

Table 19: Synthetic fertilizer Use

Year	Mg N/year
2000	116 975*
2010	95 719

** Arithmetic mean of 1999 and 2000 sales data*

ANNEX

Parameter	2000	2005	2010
Electricity import/exp. Ratio	0,91	1,19	1,13
Private cars [million]	3,8	4,2	4,4
Vehicle km on road [million km]	63 494	83 263	87 418
Steel production from Basic Oxygen steelmaking [in mio t]	4,08	6,51	6,75
Cattle [1 000 head]	2 155	1 989	1 941

Table 20: Underlying key variables for projections "with measures"

Parameter	Average for 2005 to 2010
Energy prices – Industry [% Growth per year]	
Coal	+ 2,1 %
Fuel oil	+1,5 %
Natural gas	+ 0,9 %
Electricity	+ 0,8 %
Energy prices – Households [% Growth per year]	
Coal	+ 2,0 %
Fuel oil	+ 0,5 %
Natural gas	+ 0,4 %
Electricity	+ 0,7 %

Table 21: Underlying energy price development for projections "with measures"

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This report presents Austria's emission projections for 2010 for sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and non-methane volatile organic compounds (NMVOC). It includes background information to enable a quantitiative understanding of the key socioeconomic assumptions used in the preparation of the projections. For comparison, this report also includes emission data from the 2004 national air emission inventory on which the projections were based.

This report is in accordance with UNECE/CLRTAP and EU NEC Directive 2001/81/EC. These obligations have been transposed into national law by the Emissionshöchstmengengesetz-Luft.

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