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NO_x EMISSIONS FROM STATIONARY SOURCES IN EASTERN EUROPE IN 1985

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4 NOx emissions from stationary sources in Eastern Europe in 1985

von

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Auf der Grundlage im einzelnen recherchierter Statistik-Angaben zum Brennstoffverbrauch und zur Industrieproduktion und in Auswertung des Schrifttums gewählter Emissionsfaktoren werden nationale Emissionen an NOx nach Quellgruppen und Brennstoffen berechnet. Die Emissionsfaktoren werden mit wenigen Ausnahmen einheitlich für die betrachtete Ländergruppe festgelegt. Aus diesem Grund können die ermittelten Emissionen von nationalen Angaben abweichen. Insgesamt ergibt sich für 1985 eine Emission von 7,2 Mio. Tonnen NO_2. Hieran hat die Elektrizitätserzeugung einen Anteil von ca. 50%. Im Anhang ist die räumliche Verteilung der Emissionen aus größeren Anlagen (Punktquellen) im EMEP-Raster 150 km x 150 km tabellarisch wiedergegeben.

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This work is only a part of the project on NOx emissions in Europe. The report as a whole consists of the sectorial reports Vol. I through III and the comprehensive report Vol. IV.

16. Abstract
Emission estimates of NOx from major stationary sources in Eastern Europe are presented together with the NOx emission factors and the statistics of the production of industrial goods and the consumption of raw materials. The national totals are presented as well as estimates of NOx emissions from individual sources. The total emission from stationary sources in Eastern Europe was calculated $7{,}2 \times 10^6$ t NO_2 with ca. 50% from the production of electricity. Finally, the spatial distribution of the NOx emissions from stationary sources is given within the EMEP grid of 150 km x 150 km. The calculations presented here are based on the best information available to the author, and may deviate from official national data.

17. Keywords

Emission Eastern Europe | Nitrogen oxides | Stationary source

18. Price	19.	20.

CONTENTS

NOx EMISSIONS FROM STATIONARY SOURCES IN EASTERN EUROPE IN 1985

1 INTRODUCTION

The purpose of this work is to: 1) present the NOx emission estimates from stationary sources in Eastern Europe, 2) discuss the NOx emission factors used in various regional emission inventories and, 3) relate NOx emissions to statistical data on the consumption of fossil fuels and the production of various industrial goods. The work is a part of a research project on estimating the NOx emissions from anthropogenic sources in Europe, carried out at the Norwegian Institute for Air Research under contract with the Environmental Protection Agency ("Umweltbundesamt") of the Federal Republic of Germany. The other parts of the project include: 1) the calculation of NOx emissions from mobile sources in Europe, 2) the estimation of NOx emissions from stationary combustion sources in Western Europe, and 3) a comprehensive report on NOx emissions in Europe in 1985.

The following source categories are considered: 1) production of electricity in power stations burning hard (bituminous and subbituminous) coals, brown coals including lignites, residual (heavy) oil and natural gas, 2) metallurgical coke production, 3) cement production in dry and wet kilns, 4) gas works, 5) iron and steel production, 6) coal combustion in central (district) heating and small residential units, and 7) oil and gas combustion in industrial and residential boilers.

2 NOx EMISSION FACTORS

The emission factors used in this work are presented in Tables 1-5 for various source categories. The ranges of factors given represent the ranges between the national averages. The factors for coal combustion were calculated separately for various countries considering the type and quality of coal and combustion conditions. The NOx factors for residual oil and gas combustion were mainly taken from the literature after some adjustments.

Table 1: Emission factors used to calculate NOx emissions from combustion of fuels in electric power plants in Eastern Europe in 1985 (in g NO_2/GJ_{th}).

Country	Fuel			
	Hard coal	Brown coal (Inc. lignite)	Oil	Gas
Albania		253		
Bulgaria		296	240	
Czechoslovakia	319	256	240	110
GDR		285		
Hungary	385	336	240	110
Poland	385	285		
Romania		256	240	110
European USSR	385	285	240	110
Yugoslavia		253		

Table 2: Comparison of NOx emission factors for electric power plants in Europe in 1985 (in g NO_2/GJ_{th}).

Programme/ Institution	Hard coal	Brown coal (Inc. lignite)	Oil	Gas
1. This work	319-385	253-336	240	110
2. EMEP (ECE, 1987)	150-480	199-260	100-310	60-200
3. EMEP Questionnaire	120-350		160	140
4. EEC CORINE (Bouscaren et al., 1986)	400		200	160
5. Bakkum & Veldt (1986)	340	250	280	110
6. Lübkert (1987 - review)	280-630	180-290	150-245	50-140
7. DIW (1988) - GDR		150		

Table 3: Emission factors used to calculate the NOx emissions from combustion of coal to produce heat in Eastern Europe in 1985 (in g NO_2/kg coal).

Country	Central (district) heating	
	Hard coal	Brown coal (inkl. lignite)
Albania	-	-
Bulgaria		4.0
Czechoslovakia		3.0
GDR		4.5
Hungary		4.9
Poland[1]	12.0	3.0
Romania		10.5
European USSR	12.1	3.0
Yugoslavia		3.2

1) A factor of 1.25 g NO_2/kg coal was used for small residential units.

Table 4: NOx emission factors used to calculate NOx emissions from industrial processes.

Source of information information	Coke production kg NO_2/t coal charged	Cement production kg NO_2/t cement	Iron & steel manufacturing	
			Electric Arc Furnace kg NO_2/t steel	Open Heart Furnace kg NO_2/t steel
This work	0.015	1.3	0.100	0.005
EMEP (ECE, 1987)				
- Czechoslovakia	0.7-1.3	0.9-1.4		2.5-5.4
- France			0.300	0.05
US EPA (1973)	0.02	1.3	0.100	0.005
Environment Canada (1978)	0.020	1.0		
EEC CORINE (Bouscaren et al., 1986)				0.05
SFT (1987)		1.3		

Table 5: NOx emission factors used to calculate NOx emissions from combustion of oil and gas in industrial and residential boilers in kg NO_2/TJ.

Source of information	Residual fuel oil	LPG	Coke oven gas	Blast furnace gas	Refinery gas	"City" gas
1) This work	5[1]	50	125	125	120	60
2) SFT (1987)	120	110	125		120	
3) Bakkum and Veldt (1986)	100-140	50	50-120	20-50	80-180	50
4) EMEP (ECE, 1987):						
- Finland	156					
- France	6[1]					
- Hungary	150-240					
- The Netherlands	140					
- Norway	4.2-5.0[1]					
- Sweden	170	30	100	100		30
5) Lübkert (1987)	140-240					

*[1] in kg NO_2/t residual oil.

The NOx emission factors in this work are compared in Tables 2, 4 and 5 with factors used in various European countries and in other research and assessment programmes. The factors are within the same range.

It can be noticed that the NOx factors for hard coal combustion in electric power plants, estimated in this work, agree quite well with the factors suggested by Bakkum and Veldt (1986) and Bouscaren et al. (1986).

The NOx emission factors for brown coal in this work are also within the range reported in the literature (Table 2). Generally they are lower than the factors for hard coal. A heat value of brown coal in Hungary seems to be higher than for the other brown coals resulting in a higher NOx emission factor.

Most of the oil burned in the East European power plants is imported from the USSR. Rather limited information is available on the quality

of this oil. In general, the nitrogen content of residual oil varies from 0.1 to 0.5% and is significantly lower than the content of nitrogen in coals. The measurements in Denmark (Miljøstyrelsen, 1980) showed that the NOx emission factors for oil power plants are 1.6 times lower than the factors for hard coal power plants burning Polish coal. There was no explanation on the origin of this oil but the USSR supplies at least 20% of the crude oil to Denmark. Thus the NOx emission factor of 240 g NO_2/GJ oil was estimated, close to the factors calculated by other authors (Table 2).

The NOx emission factor of 110 g NO_2/GJ for natural gas combustion to produce electricity has been accepted after Bakkum and Veldt (1986). They suggested this factor for a 900 MW power plant with 70% load firing natural gas with heat value of 32 GJ/10^3 m^3_0. This factor seems to be in a lower part of the range of NOx factors reported in the literature (Table 2).

The NOx emission factors used to calculate the NOx emissions from combustion of coal to produce heat in Eastern Europe are given in Table 3. They include factors for central (district) heating. A factor of 1.25 g NO_2/kg coal was used for small residential units.

The NOx emission factors used to calculate fossil fuel combustion in metallurgical coke production, cement plants and steel and iron foundries are presented in Table 4. They are quite similar to the NOx factors used by other authors, also presented in Table 4. However, a large variety of factors is offered in the literature for coke production. A factor used in this work is quite close to the factors used in the United States by the Environmental Protection Agency. This factor is much lower than the one used in FRG (300 g/GJ or 0.9 kg/t produced coke). Thus, the NOx emissions calculated here may be underestimated for coke production.

Finally, the NOx factors used to calculate emissions from combustion of oil and gas in small industrial and residential boilers, shown in Table 5, were taken from the literature.

3 NOx EMISSION ESTIMATES

The NOx emission estimates are presented in Tables 6-9 for various source categories. Only stationary sources are considered in this work, which is a part of the project on the NOx emissions in Europe.

The estimates are based on emission factors presented above and the statistics on the consumption of fossil fuels and the production of various industrial goods. The statistical data were collected from the national statistical yearbooks and the UN international statistics (e.g. UN, 1986) mostly for 1985. These data are also presented in Tables 6-9. The details are given elsewhere (Pacyna et al., 1988).

Table 6: NOx emissions from fossil-fuel combustion in electric power plants in Eastern Europe in 1985.

Country	Production of electricity (GWh)				NOx emission (t NO_2)			
	Hard coal-fired power plant	Brown coal power plant	Oil-fired power plant	Gas-fired power plant	Hard coal-fired power plant	Brown coal power plant	Oil-fired power plant	Gas-fired power plant
Albania		450				700		
Bulgaria		18 640	10 030			57 600	26 400	
Czechoslovakia	11 940	42 200	5 730	4 680	42 000	112 600	15 000	2 000
GDR		93 841				280 000		
Hungary	1 055	8 806	4 301	6 128	4 400	30 900	11 300	2 600
Poland	110 166	27 542			466 300	65 600		
Romania		19 894	7 071	32 957		53 200	26 000	14 000
European USSR	236 000	98 000	337 000	359 000	1 000 300	203 600	885 700	153 400
Yugoslavia		40 000				105 600		
Total	359 161	349 373	364 132	402 765	1 513 000	909 800	964 400	172 000

Table 7: NOx emissions from coal combustion to produce heat in Eastern Europe in 1985.

Country	Production of heat (in 10^6 GJ)	NOx emission (in t NO_2)
Albania	n.d.	
Bulgaria	57	28 150
Czechoslovakia	447	114 300
GDR	653	313 000
Hungary	220	71 740
Poland	806	481 200
Romania	677	304 010
European USSR	5 130	1 378 000
Yugoslavia	153	60 340
TOTAL	8 143	2 750 740

n.d. = no data available.

Table 8: NOx emissions from industrial processes in Eastern Europe in 1985.

Country	Iron and steel manufacturing				Coke production		Gas works	Cement production	
	Electric arc furnace		Open hearth furnace						
	Production (10^3 t)	NOx emission (t)	Production (10^3 t)	NOx emission (t)	Coal consumption (10^3 t)	NOx emission (t)	NOx emission (t)	Production (10^3)	NOx emission (t)
Albania					21.2	0.3		1 000	1 300
Bulgaria	956	100	301	2	13 630	20		5 717	7 430
Czechoslovakia		260[1]			11 890	178	10 970	10 300	13 390
GDR	2 420	242	3 525	18	2 870	43	24 000	11 608	15 090
Hungary	452	45	1 874	10	808	12	1 600	3 678	4 780
Poland	2 401	240	6 894	35	20 457	307	1 600	15 000	19 500
Romania	3 000	300	4 040	20	5 960	89		12 238	15 910
European USSR	19 000	1 900	85 590	400	98 850	1 482	2 400	87 700	114 010
Yugoslavia	1 155	116	1 524	8	4 702	71	440	9 315[2]	12 110
TOTAL		3 203		493		2 202	41 010	41 010	203 520

1 No data available on the technology used in the Czechoslovakian steel plants.
2 In 1984.

Table 9: NOx emissions from combustion of oil and gas in industrial and residential boilers in Eastern Europe in 1985.

Country	Consumption of fuel						NOx emission (t NO_2)					
	Fuel oil (10^3 t)	LPG (TJ)	Coke oven gas (TJ)	Blast furnace gas (TJ)	Refinery gas (TJ)	"City gas" (TJ)	Fuel oil	LPG	Coke oven gas	Blast furnace gas	Refinery gas	"City gas"
Albania[1]	600						3 000					
Bulgaria	3 025	3 188	4 000	13 500			15 130	160	500	1 690		
Czechoslovakia	4 840	6 300	67 700	60 700	11 800		24 200	315	8 463	7 588	1 416	
GDR	9 000	12 900	7 400	24 000	24 000	143 300	45 000	645	925	3 000	2 880	8 600
Hungary	1 090	15 200	4 079	17 400	6 550		5 450	760	510	2 175	790	
Poland	2 434	8 740	103 870	65 090	9 840	100 000	12 170	437	12 984	8 136	1 181	6 000
Romania		11 386	26 000	57 000	45 600			570	3 250	7 125	5 470	
European USSR	33 500	435 400	600 000	800 000	573 590		167 500	14 600	75 000	100 000	68 800	
Yugoslavia	6 000	13 800	22 333	18 119	13 879		30 000	690	2 792	2 265	1 666	

* Total consumption of various gases was 16 500 TJ and the NOx emission of 820 t assuming an emission factor of 50 g NO_2/GJ.

The total national emissions from major stationary sources in Eastern Europe are summarized in Table 10. Almost 50% of NOx emissions from stationary sources in Eastern Europe were calculated for production of electricity. Thee major mechanisms of NOx formation were considered: 1) "thermal NOx" by fixation of atmospheric nitrogen in the combustion air, 2) "fuel NOx" by conversion of chemically bound nitrogen in the fuel and 3) "prompt NOx", taking place at the front of the flame. The mechanisms are described in details by various authors (e.g. ECE, 1986). The results from the Swedish programme on the effect of coal combustion on the environment and the health hazards related to this (KHM, 1982) indicate that as much as 60% of total NOx formed during coal combustion is due to transformation of the fuel nitrogen. This was also assumed throughout the estimates here. Of course, the amounts of "thermal NOx" vs. "fuel NOx" vary due to many parameters, such as combustion conditions (type of boiler, combustion temperature, residence time, air/fuel ratio) and the N-concentrations in coals. However, only limited information was available from the literature for the Eastern European countries. Neither was available the information on the NOx control technologies, and it was assumed here that these technologies were not employed. This may cause some overestiamtion of the emissions.

The second largest stationary source of NOx in Eastern Europe was coal combustion for heating, including central (district) heating and small residential units. These emissions account for ca. 38% of total NOx emission from stationary sources there.

Combustion of residual oil and natural gas in industrial and residential boilers, as well as coal combustion in some industrial processes and gas works do not seem to be the major sources of NOx emission in the Eastern European countries.

The national totals of NOx emissions were then distributed among major point sources in a given country. Production capacity, process technology, combustion conditions and characterization of fuels were taken into account in this connection. The results are presented in Appendix A. The codes used for country, industrial branch (ind.) and process installations (instal.) were the same as in the PHOXA programme. They are also given in Appendix A.

Table 10: NOx emissions from various stationary sources in Eastern Europe in 1985 (in 10^3 t NO_2).

Source category	Albania	Bulgaria	Czechoslovakia	GDR	Hungary	Poland	Romania	European USSR	Yugoslavia	Total
1. Production of electricity	0.7	84.0	171.6	280.0	49.2	531.9	93.2	2243.0	105.6	3559.2
2. Industrial processes	1.3	7.6	24.8	39.4	6.4	21.7	16.3	120.2	12.7	250.4
3. Coal combustion for heating	n.d.	28.2	114.3	313.0	71.7	481.2	304.0	1378.0	60.3	2750.7
4. Oil and gas combustion in industrial and residential boilers	3.8	17.5	42.0	61.1	9.7	40.9	16.4	425.9	37.4	654.7
TOTAL	5.8	137.3	352.7	693.5	137.0	1075.7	429.9	4167.1	216.0	7215.0

n.d. = no data available.

4 SPATIAL DISTRIBUTION OF NOx EMISSIONS IN EASTERN EUROPE

The NOx emissions from area sources in Appendix A were spatially distributed within the EMEP grid system of 150 km x 150 km, with the help of information on population density. The NOx emissions from point sources were spatially distributed on the basis of their geographical coordinates.

The spatial distribution of NOx emissions from stationary sources in Eastern Europe is shown in Figure 1.

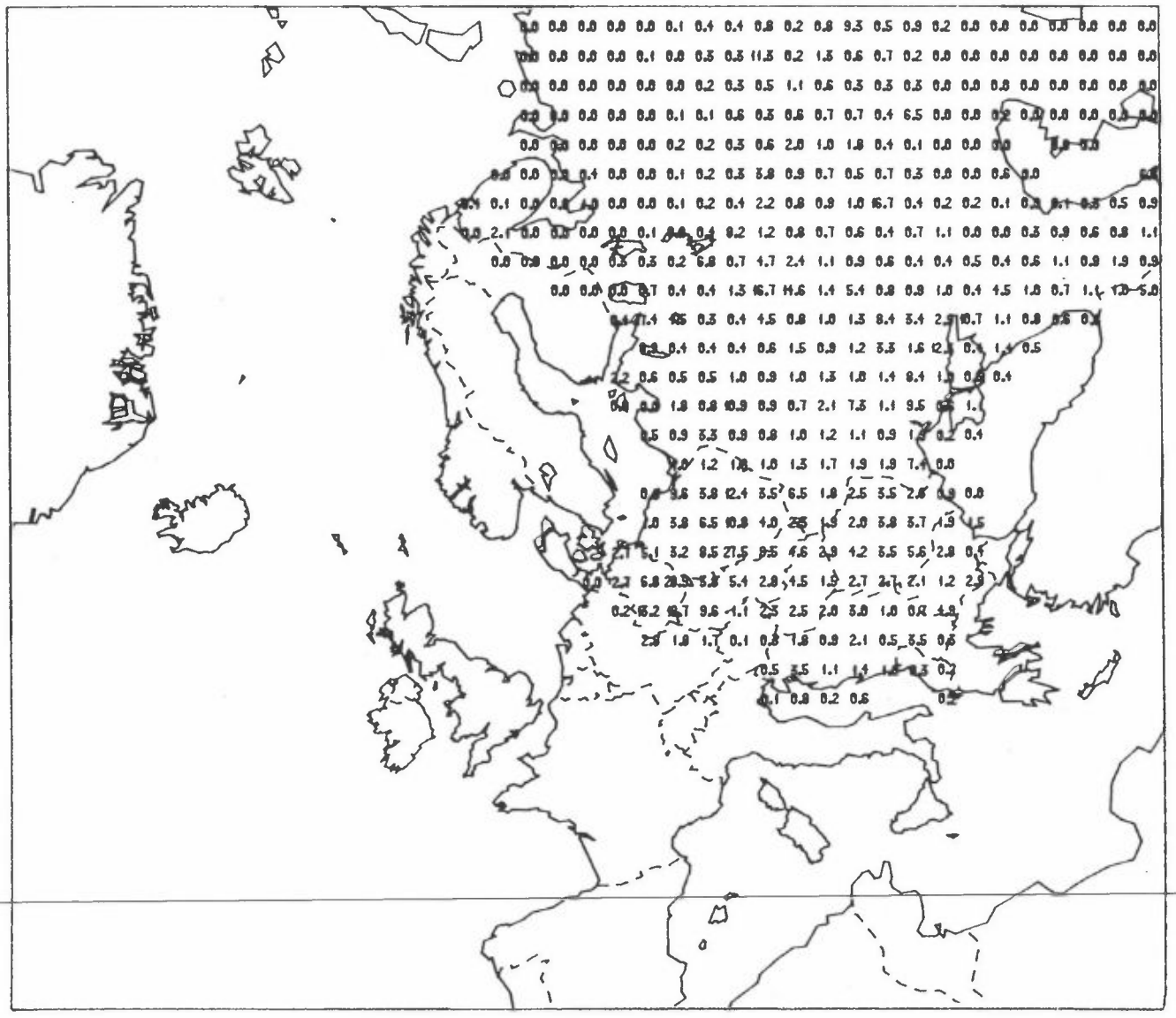

Figure 1: Spatial distribution of NOx emissions from stationary sources in Eastern Europe within the EMEP grid of 150 km x 150 km.

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The estimates presented here are based on the best information available to the author, and may deviate from official national data.

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APPENDIX A

NOx emissions from major stationary sources in the Eastern European countries.

CODES

1. Industrial branch codes:
   - 11 Conventional thermal power plants
   - 50 Primary iron and steel industry
   - 64 Building materials industry

2. Installation codes:
   - 11 Electricity generation
   - 51 Coke manufacturing
   - 52 Sinter plant
   - 54 Steel production
   - 67 Cement industry

COUNTRY CODE: 27 Albania

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Skutari	42.03	19.01	64	67	400
2	Tirana	41.20	19.49	64	67	500
3	Valona	40.29	19.29	64	67	400
4	Valona	40.29	19.29	11	11	140
5	Fier	40.44	19.33	11	11	140
6	Korcë	40.38	20.44	11	11	140
7	Tirana	41.20	19.49	11	11	140
8	Cërrik	41.01	20.02	11	11	140
	Residual fuel oil combustion					3 000
	Gas combustion					820
	TOTAL					5 820

COUNTRY CODE: 20 BULGARIA

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Sofia	42°40´	23°18´	11	11	24 500
2	Pernik	42.36	23.03	11	11	10 500
3	Maritza III	42.01	25.50	11	11	10 500
4	Maritza - Istok	42.01	25.50	11	11	10 500
5	Reka Dewnja	43.12	27.57	11	11	10 500
6	Rasgrad	43.25	25.50	11	11	10 500
7	Ruse	43.50	25.59	11	11	7 000
8	Varna	43.12	27.57	64	67	1 950
9	Pleven	43.25	24.40	64	67	1 760
10	Temelkovo	42.20	23.00	64	67	1 950
11	Dimitrovgrad	42.03	25.34	64	67	1 770
12	Sofia	42.40	23.18	50	54	26
13	Jelisseina	43.00	24.00	50	54	24
14	Pernik	42.36	23.03	50	54	24
15	Plovdiv	42.08	24.45	50	54	24
16	Kremikowzi	42.47	23.30	50	54	24
	Heat production					28 150
	Residual fuel oil combustion in residental and ind.boilers					15 130
	Gas combustion					2 350
	TOTAL					137 182

COUNTRY CODE: 12 CZECHOSLOVAKIA

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Pocerady	50 32´	13 35´	11	11	16 100
2	Ledvice	50.31	13.33	11	11	9 400
3	Tusimice	50.23	13.20	11	11	18 800
4	Prunerov	50.25	13.16	11	11	24 090
5	Brezova - Tisova	50.16	12.41	11	11	8 050
6	Vresova	50.09	12.38	11	11	4 020
7	Ervenice	50.35	13.40	11	11	1 340
8	Zaluzi	50.33	13.45	11	11	1 340
9	Melnik	50.33	14.25	11	11	16 100
10	Detmarovice	50.20	14.20	11	11	13 400
11	Ostrava	49.50	18.15	11	11	2 680
12	Karvina	49.50	18.30	11	11	1 340
13	Chvaletice	50.07	14.36	11	11	12 040
14	Porici	50.18	14.35	11	11	4 030
15	Hodonin	48.52	17.10	11	11	4 020
16	Novaky	49.39	13.49	11	11	8 050
17	Vojany	48.40	21.10	11	11	10 710
18	Litvinov	50.30	13.30	11	11	2 680
19	Plzen	49.45	13.25	11	11	2 680
20	Kosice	48.44	21.15	11	11	1 340
21	Litvinov	50.30	13.30	11	11	1 340
22	Ruzomberok	49.04	19.15	11	11	1 340
23	Sonstige	49.00	19.10	11	11	1 340
24	Vojany	48.40	21.10	11	11	5 370
25	Chomutov tube works - Chomutov	50.28	13.26	50	54	20
26	Poldi-Snop Kladno	50.10	14.02	50	54	50
27	Nova Huta Klementa Gottwalda - Kunice - Ostrawa	49.50	18.15	50	54	25

CZECHOSLOVAKIA Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
28	EASF Slovak Iron & Steelworks - Kosice	48.44 48.44	21.15 21.15	50 50	54 54	25
29	TZ Trinec/ Ostrawa	49.50	18.15	50	54	170
30	Vitkovice/ Ostrawa	49.50	18.15	50	54	60
31	Skoda/Pilzno	49.45	13.25	50	54	40
32	SZ Podbrezowa	49.45	13.25	50	54	25
33	ZDB Bohumin	49.45	13.25	50	54	25
34	Cement Plant (C.P.) Kraluv Dvur	50.00	14.00	64	67	2 380
35	CP Lochkov	50.00	14.00	64	67	1 510
36	CP Cizkovice	50.10	14.00	64	67	2 160
37	CP Prachovice	50.07	14.25	64	67	1 730
38	CP Cepicne	48.44	19.10	64	67	1 940
39	CP Hranice	49.34	17.45	64	67	1 730
40	CP Rohoznik	48.44	19.10	64	67	1 940
	Gas works					10 970
	Heat production					114 300
	Fuel oil combustion in resid. and ind. boilers					24 200
	Gas combustion					17 780
	TOTAL					352 680

COUNTRY CODE: 07 GDR

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Boxberg	51°25′	14°34	11	11	74 080
2	Hagenwerder	51.03	14.47	11	11	31 390
3	Lübbenau	51.57	13.58	11	11	28 880
4	Vetschau	51.48	14.06	11	11	25 110
5	Thierbach	51.10	12.29	11	11	15 070
6	Lippendorf	51.11	12.22	11	11	11 340
7	Vockerode	51.50	12.13	11	11	8 790
8	Jänschwalde	51.51	14.31	11	11	12 560
9	Tratendorf	51.33	14.25	11	11	8 790
10	Hirschfelde	50.57	14.54	11	11	5 040
11	Harbke	52.12	11.07	11	11	2 520
12	Lauta	51.27	14.06	11	11	3 780
13	Zschornewitz	51.43	12.24	11	11	1 260
14	Sonstige	51.20	12.25	11	11	22 490
15	Schwarze Pompe	51.32	14.22	11	11	23 860
16	Espenhain	51.10	12.28	11	11	2 520
17	Regis/Borna	51.06	12.25	11	11	2 520
18	Eisenhüttenstadt	52.20	14.32	50	52	80
19	Unterwellenborn	50.39	11.25	50	52	30
20	Brandenburg	52.25	12.34	50	54	100
21	Riesa	51.18	13.18	50	54	40
22	Henningsdorf	52.38	13.13	50	54	40
23	Thale	51.46	11.02	50	54	10
24	Karsdorf	51.16	11.39	64	67	6 040
25	Rüdersdorf	51.29	13.50	64	67	3 450
26	Bernburg	51.48	11.45	64	67	3 020
27	Deuna	51.48	11.45	64	67	2 580
	Gas works					24 000
	Heat production					313 000
	Fuel oil combustion in resid. and ind. boilers					16 050
	TOTAL					693 440

COUNTRY CODE: 14 HUNGARY

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Wieselburg-Altenburg	47°50′	17°15′	11	11	1 540
2	Odenburg	47.36	17.01	11	11	1 540
3	Szony	47.31	18.25	11	11	1 540
4	Nyirad	47.41	17.40	11	11	1 540
5	Kaposvar	46.21	17.49	11	11	1 540
6	Petfurdo	47.11	18.22	11	11	1 540
7	Komlo	46.11	18.15	11	11	1 540
8	Maza	46.10	18.10	11	11	1 540
9	Pecs	46.04	18.15	11	11	3 070
10	Kovagos-zollos	46.04	18.10	11	11	1 540
11	Oroszlany	47.28	18.16	11	11	3 070
12	Tatabanya	47.31	18.25	11	11	1 540
13	Tokod	47.46	19.08	11	11	3 070
14	Diosd	47.30	19.03	11	11	1 540
15	Budapest	47.30	19.03	11	11	3 070
16	Dunaujvaros	47.00	18.55	11	11	1 540
17	Lorinci	48.07	20.47	11	11	3 060
18	Gyongyos	47.46	20.00	11	11	1 540
19	Szolnok	47.10	20.10	11	11	1 540
20	Kazincbar-cika	48.15	20.40	11	11	1 540
21	Satoral-jaujhely	48.22	21.39	11	11	1 540
22	Debreczin	47.30	21.37	11	11	1 540
23	Tiszapakonya	47.56	21.20	11	11	3 060
24	Gyula	46.39	21.17	11	11	1 540
25	Puszta-foldvar	46.15	20.09	11	11	1 540
26	Mako	46.15	20.09	11	11	1 540
27	Ajka	47.18	17.32	50	54	v.l.
28	Dunaujvaros	47.00	18.55	50	51	40
29	"	47.00	18.55	50	54	v.l.
30	Inota	47.28	18.16	50	54	v.l.
31	Budapest	47.30	19.03	50	54	v.l.
32	Salgotarjan	48.05	19.47	50	54	v.l.
33	Zagyvarona	48.07	20.47	50	54	v.l.
34	Ozd	48.10	20.40	50	54	v.l.

HUNGARY Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
35	Borsodnadasd	48.10	20.40	50	54	v.l.
36	Apc	48.05	19.47	50	54	v.l.
37	Miskolc	48.07	20.47	50	51	30
38	"	48.07	20.47	50	54	v.l.
39	M.- Diosgyor	48.07	20.40	50	54	v.l.
40	Hejocsaba - Miskolc	48.07	20.47	64	67	2 390
41	Vac	47.46	19.08	64	67	2 390
	Gas works					1 600
	Heat production					71 740
	Fuel oil combustion in resid. and ind. boilers					5 450
	Gas combustion					4 240
	TOTAL					137 080

v.l = very low (insignificant)

COUNTRY CODE: 11 POLAND

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Siekierki - Warszawa	52.15	21.00	11	11	43 040
2	EL Zeran - Warszawa	52.15	21.00	11	11	31 090
3	Zel Bydgoszcz	53.16	17.33	11	11	7 170
4	EL Gorzow	51.01	18.21	11	11	7 170
5	EL Rybnik	50.07	18.30	11	11	9 560
6	EL Halemba - Ruda SL	50.15	18.59	11	11	7 170
7	EL Bytom	50.21	18.51	11	11	9 560
8	EL Zabrze	50.18	18.47	11	11	9 560
9	EL Bedzin	50.15	18.59	11	11	4 780
10	EL Szom-bierki - Bytom	50.21	18.51	11	11	2 390
11	EL Leg - Krakow	50.03	19.55	11	11	9 560
12	Z.E.L. Ostroleka	53.05	21.32	11	11	14 350
13	Z.E.L. Lodz	51.49	19.28	11	11	21 520
14	EL Belchatow	51.23	19.20	11	11	11 630
15	EL Konin	52.12	18.12	11	11	10 800
16	EL Patnow-Adamow	52.12	18.12	11	11	10 800
17	EL Turow-Turoszow	51.10	15.00	11	11	32 370
18	EL Jaworzno I	50.13	19.11	11	11	9 560
19	EL Jaworzno II	50.13	19.11	11	11	43 040
20	EL Jaworzno VI	50.13	19.11	11	11	9 560
21	EL Kozienice - Radom	51.26	21.10	11	11	33 480
22	EL Blachownia - Kedzierzyn	50.40	17.56	11	11	14 350
23	EL Dolna Odra - Szczecin	53.25	14.32	11	11	16 740
24	EL Lagisza - Bedzin	50.15	18.59	11	11	9 560
25	EL Polaniec - Tarnow	50.01	20.59	11	11	4 780
26	EL Siersza - Trzebinia	50.03	19.55	11	11	16 740

POLAND Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
27	EL Stalowa Wola	50.15	18.59	11	11	35 930
28	EL Skawina - Krakow	50.03	19.55	11	11	19 130
29	EL Chorzow	50.19	18.56	11	11	4 780
30	EL Laziska - Katowice	50.15	18.59	11	11	19 130
31	EL Pomorzany - Szczecin	53.25	14.32	11	11	2 390
32	EL Czechnice - Wroclaw	51.05	17.00	11	11	21 520
33	Z.E.L. Wroclaw	51.05	17.00	11	11	21 520
34	EL Gdansk	54.22	18.41	11	11	2 390
35	EL Gdynia	54.31	18.30	11	11	2 390
36	EL Szczecin	53.25	14.32	11	11	2 390
37	Huta Labedy Gliwice	50.20	18.40	50	51,54	10
38	Huta Laziska - Katowice	50.15	18.59	50	51,54	40
39	Huta Kosciuszko - Katowice	50.15	18.59	50	51,54	40
40	Huta Bieruta - Czestochowa	50.49	19.07	50	51,54	40
41	Huta Bobrek - Bytom	50.21	18.51	50	51,54	20
42	Huta Dzierzynski - Dabrowa	50.20	18.50	50	51,54	20
43	Huta Florian - Swieto-chlowice	50.15	18.59	50	51,54	10
44	Huta Katowice - Katowice	50.15	18.59	50	51,54	160
45	Huta Lenina - Krakow	50.03	19.55	50	51,54	210
46	Huta Pokoj - Ruda SL	50.15	18.59	50	51,54	20
47	Huta Zawiercie - Zawiercie	50.30	19.24	50	51,54	10
49	CEM Ozarow	50.40	17.56	64	67	130
50	CEM Strzelce Op.	50.40	17.56	64	67	3 430
51	CEM Malogoszsc - Opole	50.40	17.56	64	67	910

POLAND Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
52	CEM Kujawy - Bydgoszcz	53.16	17.33	64	67	400
53	CEM Gorazdze - Opole	50.40	17.56	64	67	200
54	CEM Chelm	51.08	23.29	64	67	2 520
55	CEM Rejowiec	51.06	23.18	64	67	1 590
56	CEM Wiek - Ogrodzieniec	51.08	23.29	64	67	3 180
57	CEM Groszowice - Opole	50.40	17.56	64	67	200
58	CEM Wysoka	50.51	20.39	64	67	1 000
59	CEM Wierzbica	51.18	22.31	64	67	3 180
60	CEM Saturn - Bedzin	50.15	18.59	64	67	400
61	CEM Nowa Huta	50.05	20.02	64	67	400
62	CEM Raciborowice - Legnica	51.12	16.10	64	67	400
63	Z.C.W. Rudniki - Czestochowa	50.49	19.07	64	67	60
64	Z.C.W. Dzialoszyn - Sieradz	51.35	18.41	64	67	1 430
65	Z.C.W. Wojcieszow - Jelenia Gora	50.55	15.45	64	67	70
	Gas works					1 600
	Heat production					481 200
	Fuel oil combustion in resid. an ind. boilers					12 170
	Gas combustion					28 740
	TOTAL					1 075 690

COUNTRY CODE: 19 ROMANIA

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Cimpia Turzi	46°33	23.53	50	54	60
2	Kalan	45.00	23.30	50	51,54	50
3	Nadrag	45.00	23.30	50	51,54	50
4	Hunedoara	45.45	22.54	50	54	50
5	Buchuresti	44.25	26.07	50	51,54	50
6	Braila	45.17	27.58	50	54	50
7	Galantz	45.27	28.02	50	51,54	50
8	Roman	46.56	26.56	50	54	50
9	Medgidia	44.15	28.16	64	67	3 980
10	Fieni/Azuga	45.30	25.00	64	67	3 980
11	Bicaz	46.53	26.05	64	67	3 980
12	Turda	46.35	23.50	64	67	3 970
13	Sathmar	47.40	23.40	11	11	2 110
14	Sasar	47.39	23.36	11	11	2 110
15	Jassy	47.09	27.38	11	11	4 210
16	Bicaz	46.53	26.05	11	11	4 210
17	Klausenburg	46.33	23.53	11	11	2 110
18	Zau de Cimpie	46.33	23.53	11	11	9 710
19	Singheorghiu	46.15	24.40	11	11	4 210
20	Uioara	46.22	23.50	11	11	2 110
21	Lucacesti	46.00	26.00	11	11	4 210
22	Darmanesti	46.22	26.30	11	11	2 110
23	Ilimbav	45.35	24.40	11	11	4 210
24	Craiova	44.18	23.47	11	11	4 210
25	Buchuresti	44.25	26.07	11	11	2 110
26	Vladeni	47.24	27.02	11	11	2 110
27	Doicesti	44.57	25.40	11	11	4 210
28	Kronstadt	45.27	25.40	11	11	2 110
29	Podeni	44.57	26.01	11	11	2 110
30	Galatz	45.27	28.02	11	11	2 110
31	Braila	45.17	27.58	11	11	2 110
32	Tulcea	45.10	28.50	11	11	2 110
33	Constanza	44.12	28.40	11	11	4 210
34	Steierdorf	44.50	22.00	11	11	2 110

ROMANIA Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
35	Reschitza	45.16	21.55	11	11	2 110
36	Parosen	45.00	23.40	11	11	9 720
37	Boita	45.00	23.30	11	11	2 110
38	Ferdinands-berg	45.35	21.15	11	11	2 110
39	Arad	46.10	21.19	11	11	2 110
40	Hunedoara	45.45	22.54	11	11	2 110
41	Gura Barza	46.22	23.30	11	11	2 110
	Heat production					304 010
	Gas combustion					16 420
	TOTAL					429 950

COUNTRY CODE: 26 YUGOSLAVIA

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Vares	44 0 10	18.20	50	51,54	40
2	Zenica	44.11	17.53	50	51,54	40
3	Topusko	45.18	15.59	50	51,54	30
4	Sissek	45.30	16.20	50	51,54	30
5	Smederewo	44.40	20.56	50	51,54	30
6	Store	46.15	16.00	50	51,54	30
7	Solin	43.33	16.30	64	67	6 060
8	Skopje	42.00	21.28	64	67	6 050
9	Trepca	42.56	20.55	32	44	7 200
10	Trifail	45.48	15.58	11	11	7 200
11	Cilli	45.48	15.58	11	11	7 200
12	Jertovec	46.15	16.00	11	11	7 200
13	Krapina	45.48	15.58	11	11	7 200
14	Zagreb	45.48	15.58	11	11	7 200
15	Rijeka	45.20	14.27	11	11	7 200
16	Banja Luka	44.47	17.11	11	11	7 200
17	Zenica	44.11	17.53	11	11	7 200
18	Kakanj	44.10	18.20	11	11	7 200
19	Sucurac	42.40	18.07	11	11	7 200
20	Elemir	45.15	19.51	11	11	7 200
21	Sabac	44.45	19.41	11	11	7 200
22	Smederevo	44.40	20.56	11	11	7 200
23	Trepca	42.56	20.55	11	11	6 000
24	Madzari	42.00	21.28	11	11	6 000
	Gas works					440
	Heat production					60 340
	Fuel oil combustion in resid. and ind. boilers					30 000
	Gas combustion					7 410
	TOTAL					216 100

COUNTRY CODE: 15 SOVIET UNION

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
1	Kolskaya	67°55′	33°01′	11	11	20 080
2	Estonskaya - Tallinn	59.22	24.88	11	11	20 080
3	Wilno	54.40	25.19	11	11	20 080
4	Leningrad	59.55	30.25	11	11	131 940
5	Kirischi	58.30	31.20	11	11	40 160
6	Lukomskaya	53.51	27.30	11	11	91 790
7	Bursztyn	54.40	20.30	11	11	63 100
8	Lady-szinskaya	49.50	24.00	11	11	41 590
9	Kanew	49.46	31.28	11	11	63 100
10	Moscow	55.45	37.42	11	11	91 770
11	Konakowo	58.01	38.52	11	11	63 100
12	Kostroma	57.46	40.59	11	11	63 100
13	Gorki	57.36	45.04	11	11	31 550
14	Nowomoskowsk	54.06	38.15	11	11	63 100
15	Kaszira	54.32	38.13	11	11	63 100
16	Smijew	50.00	37.00	11	11	71 700
17	Nowoworonez	51.15	39.11	11	11	31 550
18	Woloszilo-grad	51.00	46.40	11	11	123 340
19	Saratow	51.30	45.55	11	11	31 550
20	Nowoczer-kassk	47.25	40.05	11	11	100 390
21	Staro-beszewskaya	47.05	37.34	11	11	100 390
22	Moldawskaya	46.30	30.46	11	11	63 100
23	Kriwoi Rog	47.55	33.24	11	11	71 700
24	Pridneprowsk	48.29	35.00	11	11	51 630
25	Jerewan	40.10	44.31	11	11	40 160
26	Baku	40.22	49.53	11	11	51 630
27	Ali - Bairamly	39.00	49.50	11	11	40 160
28	Sainsk (Kujbyszew)	53.19	66.55	11	11	40 160
29	Perm	58.01	56.10	11	11	100 390
30	Karmanowo	55.49	34.51	11	11	40 160
31	Sverdlowsk	56.52	60.35	11	11	71 700
32	Czelyabinsk	55.12	61.25	11	11	71 700

SOVIET UNION Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
33	Troizk	54.08	61.33	11	11	63 100
34	Magnitogorsk (Jushno - Uralsk)	53.28	59.06	11	11	80 350
35	Uralsk (Irklinski)	51.19	51.20	11	11	63 100
36	Stawropol	45.03	41.59	11	11	40 160
37	Inta	66.04	60.01	11	11	10 040
38	Vorkuta	67.27	64.00	11	11	8 600
39	Archangelsk	64.35	39.50	11	11	8 600
40	Nizhniy Tagil	58.00	59.58	50	50,54	100
41	Magnitogorsk	53.28	59.06	50	50,54	100
42	Chelyabinsk	55.12	61.25	50	50,54	100
43	Novotroizk	51.11	58.16	50	50,54	100
44	Zlatoust	55.10	59.38	50	50,54	100
45	Alapayevsk	57.55	61.42	50	50,54	100
46	Orsk	51.13	58.35	50	54	100
47	Serov	59.42	60.32	50	54	100
48	Sverdlovsk	56.52	60.35	50	54	100
49	Lysva	58.07	57.49	50	54	100
50	Ascha	54.00	57.00	50	54	100
51	Beloretsk	53.59	58.20	50	54	100
52	Kamensk Uralski	56.29	61.49	50	54	100
53	Cherepovets	59.09	37.50	50	54	100
54	Izhevsk	56.49	53.11	50	54	100
55	Omutnisk	58.35	52.28	50	54	100
56	Leningrad	59.55	30.25	50	54	100
57	Kolpino	59.44	30.39	50	54	100
58	Olenegorsk	68.04	33.15	50	51,54	90
59	Moscow & Noginsk	55.45	37.42	50	54	90
60	Gorki	57.36	45.04	50	54	90
61	Kosaya Gora & Tula	54.08	37.33	50	51,54	90
62	Lipetsk	52.37	39.36	50	54	90
63	Vyksa	54.37	39.43	50	54	90
64	Kriwoi Rog	47.55	33.24	50	50,54	90

SOVIET UNION Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
65	Dneprodzer-zhinsk	48.30	34.37	50	54	90
66	Dneprope-trovsk	48.29	35.00	50	54	90
67	Zaporozhye	47.50	35.10	50	54	90
68	Kerch	45.22	36.27	50	51,54	90
69	Voroshilovsk	51.08	46.39	50	54	90
70	Yenakiyevo	48.14	38.15	50	54	90
71	Makeyevka	48.01	38.00	50	51,54	90
72	Donetsk	48.00	37.50	50	51,54	90
73	Konstan-tinovka	48.33	37.45	50	51,54	90
74	Taganrog	47.14	38.55	50	54	90
75	Zhdanov	47.05	37.34	50	54	90
76	Volgograd	48.45	44.30	50	54	90
77	Sestafoni	42.15	42.44	50	54	90
78	Dashkesan	40.29	46.05	50	51,54	90
79	Sumgait	40.35	49.38	50	54	90
80	Volkhov	59.54	32.15	64	67	3 570
81	Kunda	59.30	26.30	64	67	3 570
82	Riga	56.53	24.08	64	67	3 570
83	Belgorod	50.38	36.36	64	67	3 570
84	Volsk	52.04	47.22	64	67	3 570
85	Mikhaylovka	50.05	43.15	64	67	3 570
86	Balakleya	49.27	36.53	64	67	3 570
87	Amvrosiyevka	47.46	38.30	64	67	3 570
88	Tokmak	47.13	35.43	64	67	3 570
89	Moscow	55.45	37.42	64	67	3 560
90	Kolomna	55.05	38.45	64	67	3 560
91	Ryazan	54.37	39.43	64	67	3 560
92	Dobromino	53.00	39.00	64	67	3 560
93	Bryansk	53.15	34.09	64	67	3 560
94	Lipetsk	52.37	39.36	64	67	3 560
95	Voronezh	51.40	39.13	64	67	3 560
96	Kharkov	50.00	36.15	64	67	3 560
97	Kramatorsk	48.43	37.33	64	67	3 560

SOVIET UNION Cont.

NO	SOURCE NAME	GEOGRAPHICAL POSITION		CODES		EMISSION
		LATITUDE	LONGITUDE	IND.	INSTAL.	t/y
98	Dneprodzerzhinsk/ Dneprope-trovsk	48.30	34.37	64	67	3 560
99	Kriwoi Rog	47.55	33.24	64	67	3 560
100	Amayansk	47.50	32.20	64	67	3 560
101	Novorossiysk	44.44	37.46	64	67	3 560
102	Vorkuta	67.27	64.00	64	67	3 560
103	Novo - Pashiysiy	58.00	59.00	64	67	3 560
104	Nizhniy Tagil	58.00	59.58	64	67	3 560
120	Nevyansk	57.34	60.10	64	67	3 560
121	Yemanzhe-lansk	54.50	61.22	64	67	3 560
122	Katav Ivanovsk	54.45	58.11	64	67	3 560
123	Ufa	55.46	60.08	64	67	3 560
124	Magnitogorsk	53.28	59.06	64	67	3 560
125	Novotroitsk	51.11	58.16	64	67	3 560
126	Orsk	51.13	58.35	64	67	3 560
	Gas works					2 400
	Heat production					1 378 000
	Fuel oil combustion in resid. and ind. boilers					167 500
	Gas combustion					258 400
	TOTAL					4 167 090

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TITTEL NOx emissions from stationary sources in Eastern Europe		PROSJEKTLEDER A. Semb	
		NILU PROSJEKT NR. O-8668	
FORFATTER(E) J.M. Pacyna		TILGJENGELIGHET B	
		OPPDRAGSGIVERS REF.	

OPPDRAGSGIVER (NAVN OG ADRESSE)
Umweltbundesamt
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3 STIKKORD (à maks. 20 anslag)
Utslipp | Nitrogenoksider | Stasjonær forbrenning

REFERAT (maks. 300 anslag, 7 linjer)
Utslipp av nitrogenoksider fra stasjonære kilder i Øst-Europa er beregnet for 1985 på grunnlag av statistiske oppgaver og utslippsfaktorer. Utslippene er fordelt på EMEP-rutenett, ved hjelp av befolkningsstatistikk og lokalisering av varmekraftverk og andre store utslippskilder.

TITLE NOx emisssions from stationary sources in Eastern Europe

ABSTRACT (max. 300 characters, 7 lines)
Emissions of nitrogen oxides from stationary combustion sources have been estimated for 1985 on the basis of statistical data and emission factors. Distribution in EMEP grids (150 x 150 km^2) was based on the position of thermal power plants and other major emission sources, and population densities.

* Kategorier: Åpen - kan bestilles fra NILU A
Må bestilles gjennom oppdragsgiver B
Kan ikke utleveres C