BALTIC SEA ENVIRONMENT PROCEEDINGS

No. 67

WORKSHOP ON THE REDUCTION OF EMISSIONS FROM TRAFFIC IN THE BALTIC SEA AREA

23–27 January 1995
Rostock-Warnemünde, Germany

HELSINKI COMMISSION
Baltic Marine Environment Protection Commission

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Foreword

The Baltic Sea is still strongly negatively effected by eutrophication symptoms. Beside direct inputs via river and direct discharges into the Sea, the atmospheric nitrogen emissions add substantially to the nitrogen load of the Baltic Sea. Not only the atmospheric emissions direct to the surface of the Baltic Sea should be counted but also the deposition on the land masses of the convention area. Based on simple assumptions the atmospheric emissions supply more than 50% of the nitrogen load of the Baltic Sea.

Main contributor of the atmospheric load is the traffic. This sector grows dynamically in all Baltic Sea riparian states. In spite of the introduction of three-way-catalyst cars and cleaner lorries and buses in the western oriented states the reduction of the NOx emissions is, if at all, small so far. New links between the countries in transition and the Western European countries will increase the future transportation within the Baltic Sea convention area. Within the frame of the Helsinki Commission Germany organised a workshop on emissions from land based traffic with the aim, inter alia, to develop a draft recommendation for the reduction of the load caused by land based transportation. Most of the Baltic Sea riparian states submitted contributions. This publication contains the manuscripts of the presentations given at the workshop with additions.

As the Chairman of the workshop I would like to thank all authors as well as participants for their contributions to the outcome of the workshop. I would also like to thank the Institut für Meereskunde, Warnemünde for the hospitality and for the excellent arrangements during the seminar.

Finally I would like to thank the Secretariat of the Helsinki Commission for their support and co-operation and Mr. Ulrich Kremser for the organisation of the meeting.

Axel Friedrich

20 february 1995

National presentations concerning present situation with regard to traffic emissions, future development and measures. The workshop on: Reduction of pollution from traffic 23-26 January 1995.

DENMARK.

Referring to the danish contribution to the Preparatory Commitee of the 1996 Regional Conference on Transport and the Environment, we can contribute with following:

Data on **fuel consumption for the year** 1975 - 1992 for the various modes of transport, and CO_2 for the year 1990.

	Fuel consumption [PJ]					
	1975	1980	1985	1990	1991	1992
Pass.cars	62,15	61,03	63,27	72,2	74,02	75,05
Busses/coaches	2,33	3,89	4,21	6,7	6,49	6,34
Light trucks 1)	24,34	35,86	47,31	51	50,8	51,57
Heavey trucks						
Total rd. trans.	**88,82**	**100,78**	**114,79**	**129,9**	**131,31**	**132,96**
Pass. trains	3,96	4,57	5,02	5,1	5,18	4,08
Freight trains	1,43	1,55	1,47	0,7	0,8	0,95
Total traintrans.	5,39	6,12	6,49	5,8	5,98	5,03
Inland navigation 2)	4,56	4,34	4,51	5,06	7,63	6,92
Maritime transp.	2,30	1,25	1,09	1,28		
Domestic Air transp.	1	0,83	0,64	0,9	0,81	0,73
Total trans. sector	97,51	108,98	123,01	137,88	138,1	138,72
Total country 3)	757	811	792	820	826	826

1) Light- and heavy trucks
2) 1991 and 1992 including maritime transport
3) Gross energy consumption

1990 CO2 emission [1000 t]	
Pass.cars	5 301,5
Busses/coaches	500,7
Light trucks	2.164,4
Heavey trucks	1.647,9
Total rd. trans.	9.614,5
Pass. trains	729,6
Freight trains	53,2
Total traintrans.	782,8
Inland navigation	379,7
Maritime transp.	96,1
Domestic Air transp.	67,4
Total trans. sector	10 940,5

Below is specified the type of fuel for road vehicles 1980-1992

Fuel consumption for road vehicles 1980–1992

		All veh. consumption [1000t]			
		1980	1985	1990	1992
Gasoline:	leaded	1.460	1.480	940	510
	unleaded	0	0	710	1.190
Total		1.460	1.480	1.650	1.700
Diesel		850	1.160	1.370	1.410
LPG		60	60	10	4
Total		2.370	2.700	3.030	3.114

Below is listed the electric energy consumption for trains

Energy consumption [MJ]

	1990	1991	1992	1993
Pass. trains	3.840	3.717	3.595	3.534
Freight trains	709	718	717	670
Total train transp.	4.549	4.435	4.312	4.204

Below is listed the emissions other than CO_2 for different modes of transport.

Emissions other than CO2

	CO	NOx	HC	SO2	Part.
1980 Emissions [1000t.]					
Pass. cars	555	43	67	...	0,2
Light trucks (<3,5t.)	79	5	9	...	0,3
Heavey trucks (>3,5t.)	33	30	6	...	3,2
Total road transp.	667	78	82	9,9	3,7
1985 Emissions [1000t.]					
Pass. cars	442	51	70	...	0,4
Light trucks (<3,5t.)	50	5	6	...	0,6
Heavey trucks (>3,5t.)	34	31	6	...	3,2
Total road transp.	526	87	82	13,0	4,2
1990 Emissions [1000t.]					
Pass. cars	465	62	84	...	0,7
Light trucks (<3,5t.)	36	7	5	...	1,1
Heavey trucks (>3,5t.)	35	33	7	...	3,4
Total road transp.	536	102	96	7,1	5,2

1990 Emissions other than CO2 [1000 tons]

	CO	NOx	HC	SO2	Par.
Pass. trains	0,4	4,9	0,9	1,4	0,2
Freight trains	0,0	0,9	0,2	0,0	0,0
Total train transp.	0,4	5,8	1,1	1,4	0,2
Total inland w	2,0	7,2	0,4	2,0	0,3
Total maritime	0,5	1,8	0,0	0,5	0,0
Domestic air	1,0	1,2	0,3	0,0	...

About the forecast of emission and sources for the year 2005 se the tables shown below.

The forcast (2005) of the tansport demand for various modes of transport

2005	Passenger-km [mio]	Tonne-km [mio]
	a	a
Pass.cars	64.849	...
Busses/coaches	9.300	...
Light trucks 1)	...	674
Heavey trucks	...	14.159
Total rd. trans.	**74.149**	**14.833**
Total traintransp.	**5.629**	**506**
Total inland navigation	**290**	**...**
Total maritime transp.	**...**	**1751**
Total domestic Air transp.	**550**	**...**

The forecast (2005) of the fuel consumption is shown in the table below for the year 2005.

2005	Fuel consumption [1000 t.]	CO_2 emissions [1000 t.]
	a	a
Pass.cars	83,3	6.117
Busses/coaches	5,9	443
Light trucks	31,2	2.332
Heavey trucks	26,4	1.985
Total rd. trans.	**146,9**	**10.877**
Pass. trains	2,7	354
Freight trains	0,2	25
Total traintrans.	**2,9**	**378,5**
Inland navigation	2,2	166,5
Maritime transp.	1,1	81,9
Domestic Air transp.	0,9	85,6
Total trans. sector	153,9	11.569,3

The forcast (2005) of emissions other than CO_2 for various modes of transport.

2005: Emissions other than CO2 [1000 tons]

	CO	NOx	HC	SO2	Par.
Pass. cars	260,7	20,6	34,9	1,9	0,5
Bus/coaches	1,5	3,8	0,8	0,1	0,3
Light trucks	28,1	10,2	1,9	0,7	0,8
Heavey trucks	7,2	5	4	0,6	0,8
Total road transp.	**297,5**	**39,6**	**41,6**	**3,3**	**2,4**
Pass. trains	0,2	2,2	0,2	0,7	0,2
Freight trains	0	0,1	0	0	0
Total train transp.	**0,2**	**2,3**	**0,2**	**0,7**	**0,2**
Total inland	**0,8**	**3,4**	**0,2**	**0,1**	**0**
Total maritime	**0,5**	**1,7**	**0**	**0,4**	**0**
Domestic air	**0,7**	**1,7**	**0,2**	**0**	**...**
Total transp. emissions	299,7	48,7	42,2	4,5	2,6

TRAFFIC EMISSIONS IN ESTONIA

Tiit Metsvahi- Tallinn Technical University
Dago Antov- IB Stratum

Estonia is a country at the Baltic Sea, it's territory is 45227 sq.km and population is 1.49 millions (1.01.1995).

The transportation system in Estonia consists of:

- well developed rural road network (43 825 km)
- retrograded railway network (1024 km)
- urban street network (2920 km)
- waterways
- airway's system.

The transportation policy in the Baltic States, especially in Estonia is facing a period of reorientation mainly because of the new institutional structures have to manage under new conditions with the intention of decentralizing economy and the growth of responsibility.

We can basically separate 3 periods of transportation's policy during last 10...15 years:
i) period of stagnation
ii) period of transormation
iii) period of new situation

Each of these periods has basic characteristic elements, which could be formally described by car ownership levels, traffic volume and vehicle park characteristics, etc.

Road traffic is the biggest emission source if comparing all emissions, thus we pay more attention on this point- where we can see the developing of car ownership and kilometrage's dynamics in following tables.

Of stationary sources' (energy production, industry) emissions were reliably available only two compounds in 1991/92. There are presented in the figure both traffic and stationary sources. Road traffic is responsible for 55% of the total nitrogen oxide emissions. Today this portion is even bigger, as traffic has grown by 2.2 times, when the number of stationary emission sorces has been decreased and existing sources are working with less power.
Road traffic was responsible for only one percent of the sulphur dioxide total emissions in 1992.

The highest level of air pollution was found to be in Estonia in 1989-1990, when traffic volumes were high, and vehicles were mainly soviet made automobiles with high pollution rate and same time also stationary pollutant were working with maximum power.

The lowest level of air pollution was in 1992, when traffic was low. Comparing with 1991 traffic volumes were onky 50% and urban traffic only 75% of it's previous year level. Same time the number of cars was still increasing, only the number of lorries and trucks was decreased. Also a number of stationary pollutant were stopped.

In all compounds, road traffic was found to be the greatest emission source. As for the effects of emissions, road traffic has an even greater importance than is seen in the percentages, because emissions from road traffic comes into the vicinity of human habitation, especially in cities.
As can be seen, traffic is responsible for, more than half of the total emissions of nitrogen oxides. In sulphur dioxide, traffic is responsible only for one per cent of the total emissions. These proportions are generally the same as in Finland e.g., which shows that traffic in Estonia is not exceptional in its emissions compared to other emission sources.

Today's situation is different, because of quick changes in vehicles' fleet. The portion of western made vehicles is increasing. Even when they are mainly second hand cars, there age is decreasing every year.

The portion of soviet or Russian made cars is now 51%, but their portion in traffic is even less.
Similar tendencies could be found if looking heavy vehicles' park. 20% of trucks and 15% of buses are now western made.

Fuel consuming in Estonia (thousand of tons)*

Type of fuel	Years					
	1985	1990	1991	1992	1993	1994
Gasoline	486	523	473	228	235	286
Diesel fuel	673	604	586	375	414	377
Aviation fuel	34	35	36	12	18	15
TOTAL	1193	1163	1095	625	667	678
TJ	51 550	50 350	47 400	26 479	28 700	29 300
in transportation**	21 338	18 055	15 007	12 281	13 449	16 258
%	41.4	35.9	31.7	46.4	46.9	55.5

* by Estonian Statistical Administration
** without private cars' fuel consumption

Calculated fuel consumption by automobiles (thousand of tons)

Type of fuel	Years			
	1989	1992	1994	1995*
Gasoline	476	261	347	323...350
Diesel fuel	167	112	365	364...372
TOTAL TJ	28 340	16 549	30 864	30 052...30 912

- Different methods used

Official statistical data of fuel consumption is less than calculated on the basis of traffic volumes. Here we can find two explanations. First- used for calculations average fuel consumption could be more i.e. real vehicles are more economical and 20...25% of registered vehicles are not in practical use. Secondly- we know, that a portion of selled fuel is out of official statistics.

Kilometrage share by vehicle types (in million km)

Vehicle type	Years			
	1989	1992	1994	1995
Cars*	2500	2047	4734	5405
Buses	320	130	180	198
Trucks and lorries	1518	787	961	886
TOTAL	4338	2964	5875	6489

Road Network in Estonia 1995

	Length	Density	
	km	km per sq.km	km per 1000 inh.
Roads in total	43 825	0.969	29.4
include. Public Roads	14 992	0.331	10.0
Urban Streets	2920	0.065	2.0
TOTAL	46 745	1.034	31.3
railways	1024	0.023	0.7
waterways	520	0.011	0.3

Exhaust emissions from traffic in Estonia (tons per year)

Traffic mode	Year	CO	HC	NOx	Part.	SO_2	CO_2
Road traffic	1995	122 562	32 951	35 818	2599	4337	2 247 000
	1994	117 277	34 522	32 720	2288	4349	2 243 974
	1992	74 300	21 800	14 590	1070	1640	1 180 000
Railway traffic		678	339	1960	188	151	122 000
Air traffic		1060	734	206	22	33	183 000
Waterway traffic		453	255	1150	95	755	117 000
TOTAL	1992	76 500	23 500	17 800	1380	2580	1 600 000
Road traffic	1989	172 970	59 090	30 070	2250	3150	2 042 121

Registered vehicles in Estonia shared by age (1995)

	Age				
Vehicle type	<3 years	3...8 years	8...10 years	>10 years	TOTAL
Motorcycles	73	855	257	2081	3266
Cars	10 567	59 764	65 811	247 302	383 444
include private	3434	46 029	59 463	233 227	342 153
Lorries	1622	16 581	12 955	34 440	65 598
include private	106	3511	4428	17 748	25 793
Buses	262	1958	1443	3346	7009
include private	10	303	274	1099	1686
TOTAL	12 524	79 158	80 466	287 169	459 317
include private	3623	50 698	64 422	254 155	372 898
% private	28.9	64.0	80.1	88.5	81.2

Number of vehicles (1985-1995)

Year	Total Number of vehicles	Include: Cars	Lorries and special vehicles	Buses	Growth in % if comparing with 1985
1985	243 400	177 000	58 900	7500	100.0
1990	317 600	242 000	67 700	7900	130.5
1991	346 771	261 086	77 057	8628	142.5
1992	366 427	283 469	74 558	8400	150.5
1993	400 200	317 400	74 100	8700	164.4
1994	397 885	337 812	53 733	6340	163.5
1995	456 051	383 444	65 598	7009	187.4

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HELCOM WORKSHOP ON THE REDUCTION OF EMISSIONS FROM TRAFFIC IN THE BALTIC SEA AREA

Rostock-Warnemünde 23.1.-27.1.1995

1 Introduction

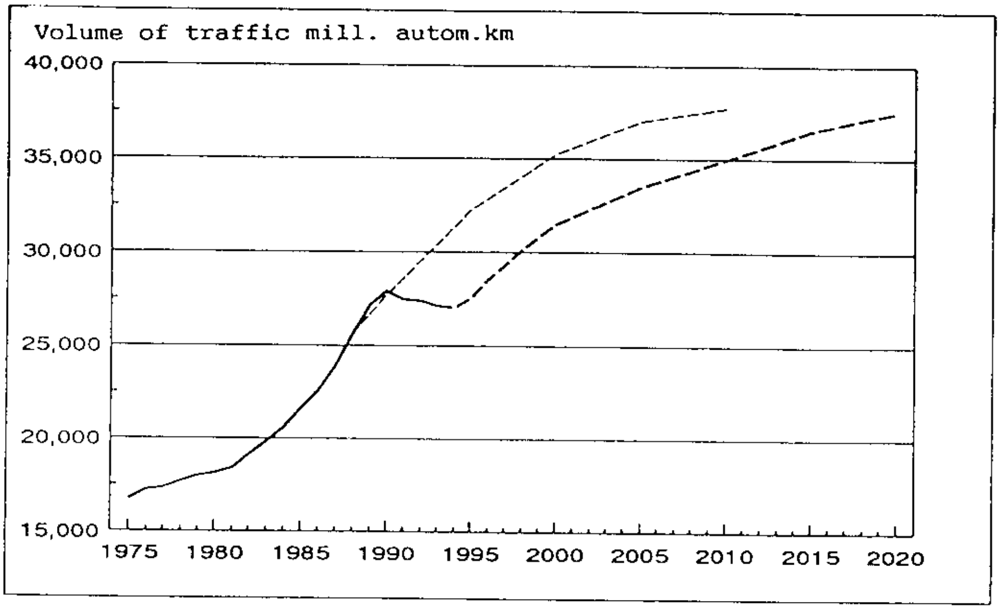
To move freely is one of the basic rights of citizens. The growth of traffic, however, has lead to a number of serious environmental problems all over the world. Transport affects, among other things, energy consumption, environment and human health. The objectives within the framework of transport, economy and security, and the need for developing community structure and regional structure should accordingly be harmonized with environmental objectives.

Finland covers some 338 150 square kilometres. The total population is 5 million, of which 60 % live in towns. Because of its small population and large area, Finland is a country with long distances from place to place. We are also rather far away from our main markets. These factors, combined with the characteristic structure of industry, tend to increase traffic volumes. The distances driven by heavy goods traffic are about double the European average, and though the actual car density is around the European average, people drive more kilometres per year than Europeans (18 800 km/vehicle in 1993). More basic information about transport in Finland is provided in appendix 1.

2 Traffic volumes

Economic development in Finland has not corresponded the growth expectations of the late 1980's. In fact, there has been an overall decline in the last years. Also the traffic growth has been slower than anticipated, and therefore the traffic forecast for public roads in Finland was revised downwards in 1994 (figure 1). According to the revised forecast, road traffic will increase by 40 % during the years 1993-2020.

Figure 1. Traffic performance in 1975-1993, forecast for 1989-2010 and revised forecast for 1994-2020 (Source: Finnish National Road Administration)



——— = Traffic performance 1975-1993
--- = Forecast 1989
--- = Forecast 1994

The breakdown into different modes of transport in Finland is similar to that in the European Union, except that sofar bus transport plays a more prominent role in Finland and air transport a smaller one. Overall trends in the last two decades are, however, very much the same. Demand for all forms of transport has grown since 1970. Air traffic has expanded most, becoming fourfold. Passenger car traffic has doubled and rail traffic increased by 50 % (figures 2, 3).

Figure 2. Trends in domestic passenger transport (1970 = 100) (Source: Ministry of Transport and Communications)

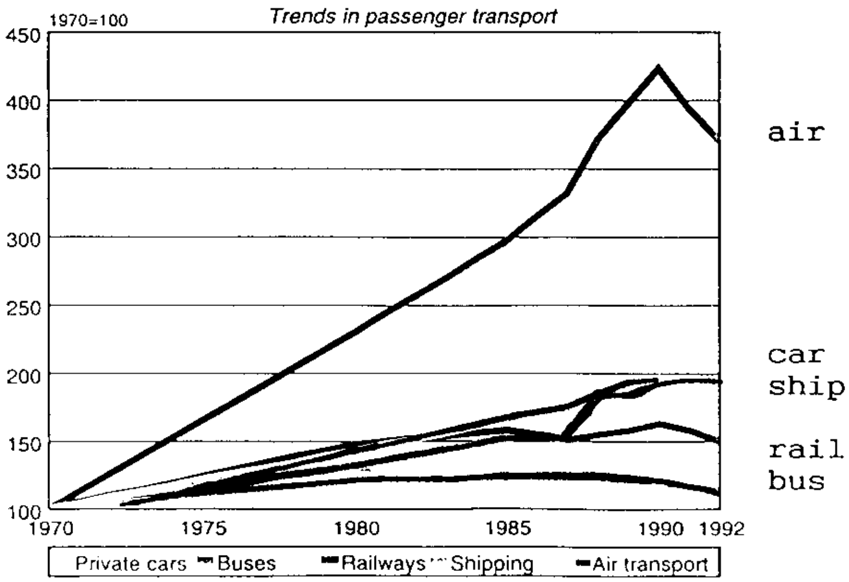
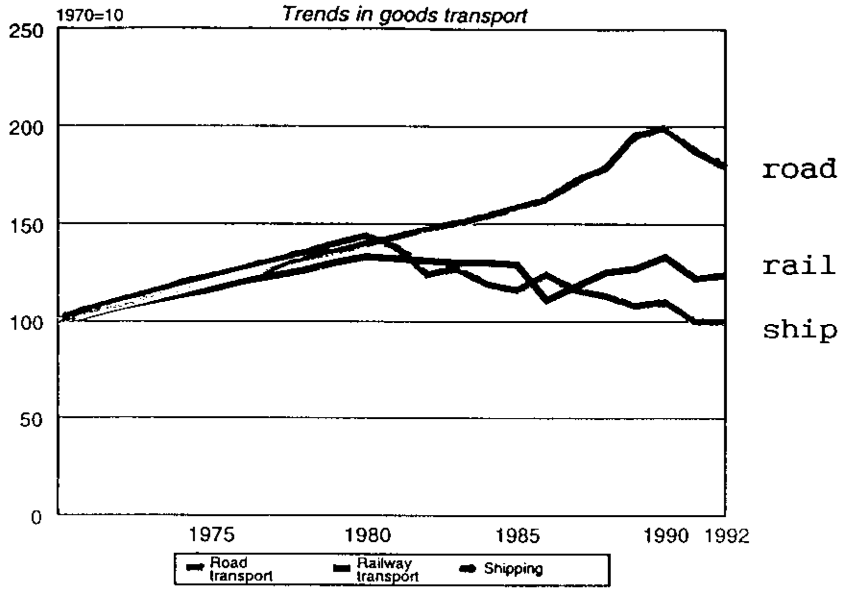


Figure 3. Trends in domestic goods transport (1970 = 100) (Source: Ministry of Transport and Communications)



3 Emissions

3.1 International obligations and reduction targets

Finland has, under the Convention on Long-Range Transboundary Air Pollution (LRTAP Geneva 1979), committed itself to reduce the emissions and their transboundary fluxes of sulphur dioxide, nitrogen oxides and volatile organic compounds. These reduction targets are summarized in table 1.

Table 1. Commitments and emission reduction targets under the LRTAP (1979) in Finland

Protocol		Reduction	Base year	Target year
SO_2	Helsinki'85	protocol - 30 %	1980	1993
	Helsinki'85	objective - 50 %	1980	1995
	Oslo'94	protocol - 80 %	1980	2000
NO_x	Sofia'88	protocol "freeze"	1987	1994
	Sofia'88	declaration -30 %	1980	1998
VOC	Geneva'91	protocol -30 %	1988	1999

With regard to carbon dioxide emissions, Finland has signed and ratified the United Nations Framework Convention on Climate Change which took effect globally in March 1994. Finland's National Report under the Convention was finalized in January 1995.

Finland is also implementing the Vienna Convention for the Protection of the Ozone Layer (1985) and the Montreal Protocol (1987) with its subsequent amendments.

3.2 Total emissions and emission reductions

The main emphasis in air pollution control in Finland has been on limiting emissions of acidifying emissions e.g. sulphur and nitrogen oxides. The total emissions into the air in Finland and the emissions by different sectors in 1993 are shown in tables 2 and 3 respectively.

Sulphur dioxide

In 1991, the Finnish government set a target to reduce sulphur emissions by 80 % from the 1980 level by the year 2000. This target was reached in 1994 (preliminary information). Structural changes in the energy sector, introduction of low sulphur fuels, as well as development of the processes in the pulp and paper industry and chemical industry have contributed to this aim. In order to retain the objective, however, further actions are needed. The Second Finnish Sulphur Committee has proposed in 1994 the following limit values for the sulphur content in fuels: light fuel oil 0,1 %, diesel oil 0,05 %, petrol 0,01 %, and heavy fuel oil used in domestic marine traffic 1,5 % by weight.

Nitrogen oxides

With regard to nitrogen oxides, the development has not been as favourable as with sulphur. Growing traffic and increasing energy production continued to inflate emissions of nitrogen oxides throughout the 1980's. By 1993 the emissions had decreased by less than 5 %. The Nitrogen Committee set by the Ministry of the Environment estimated in its report in 1990 that a 15 % reduction would be possible from 1980 to 2000 by applying those technical measures which had already been implemented or agreed upon, e.g. new combustion technology and flue gas scrubbing in energy production, new techniques in heavy diesel engines, and catalytic converters in new petrol driven cars. The Ministry of the Environment is about to revise the reduction strategies and update the emission prognosis for nitrogen oxides in 1995.

Volatile organic compounds

In 1992, it was estimated that by the target year 1999 the emissions of volatile organic compounds (NMVOC's) would be reduced by 35% as a consequence of decisions already taken or measures most probably to be implemented, including tighter emission limits for petrol driven cars, further reductions in petrol storage and distribution and the use of solvent-free and low-solvent products. Furthermore, with economically feasible technical means it would seem possible to reach even 40-50 % reduction. The latest emission inventory from 1993 showed only 10 % reduction in overall NMVOC emissions compared to the 1988 level. Emissions from stationary sources were reduced by some 20 %, but the expected decrease of emissions from traffic sources had not been realized. The reason for this is the economic recession which prevents people from buying new cars, and industry from investing in new technology. Also, the legislative framework and binding regulations concerning VOC reduction have to be completed.

Carbon dioxide

In 1990 carbon dioxide emissions totalled some 54 million tonnes in Finland. In line with the Convention on Climate Change, Finland is taking action to mitigate climate change by limiting emissions of greenhouse gases and enhancing sinks and reservoirs. Nevertheless, emissions will probably grow from 1990 to 2000. In the most likely option, emissions in 2000 would be 69 million tonnes. This option takes account of cuts brought about by energy taxation, energy conservation, more use of bioenergy and the adoption of new technology. Depending on arrangements concerning the baseload capacity and the amount of electricity imported, annual carbon dioxide emissions could well decline further, reaching some 65 million tonnes in 2000 and about 64 million in 2010.

Table 2. Annual total emissions 1980-1993 in Finland and an estimate for year 2000 (1000 tonnes) excluding bunkers

	1980	1988	1990	1991	1992	1993	2000
SO_2	**584**	302	260	194	139	120	116
NO_2 1)	**264**	276	290	286	257	253	224
NH_3	n.a.	n.a.	41	n.a	41	n.a.	32
NMVOC	n.a.	**210-215**	219	n.a.	n.a.	193-196	150
CO_2 2)	n.a.	n.a.	**54**	n.a.	n.a.	n.a.	65-69

1) NOx emissions expressed in NO2, 2) 10^6 tonnes from fuels

Table 3. Emissions into the air by sectors in 1993 (1000 tonnes) (Source: Statistics Finland, Technical Research Centre of Finland)

	NO_2	%	SO_2	%	HC/VOC	%
Energy production	78	31	76	63	32	17
Industrial processes	20	8	40	33	60	31
Traffic total	121	48	3	3	91 1)	47
road traffic	113	-	1	-	79	-
Work machinery	34	13	1	1	10	5
Total	**253**	**100**	**120**	**100**	**193**	**100**
Int. waterway traffic	32	-	12	-	n.a	-

1) incl. vehicle maintenance, road surfacing, fuel distribution

3.3 Traffic exhaust emissions

Transport accounts for some 15 % of total consumption of primary energy and 40 % of oil consumption in Finland. The major local air pollution problem today is exhaust emissions from road traffic and dust raised from the road surfaces.

Almost half of all nitrogen oxide and hydrocarbon emissions in Finland and for about 25 % of the carbon dioxide emissions come from traffic. Traffic is also the most important source of carbon monoxide emissions. The share of traffic originated lead used to be high as well but due to the use of catalytic converters and unleaded petrol it is now neglitable.

The exhaust emissions of different transport modes and types of vehicles is shown in table 4. It should be noted that the data is from year 1990. The development of road traffic emissions in 1980-1990 and estimations for the future are given in appendix II. The revised emission inventory and forecast for road traffic emissions is expected to be ready by the spring 1995 (Technical Research Centre of Finland).

Table 4. Exhaust emissions from transport sources in 1990 (Source: Statistics Finland)

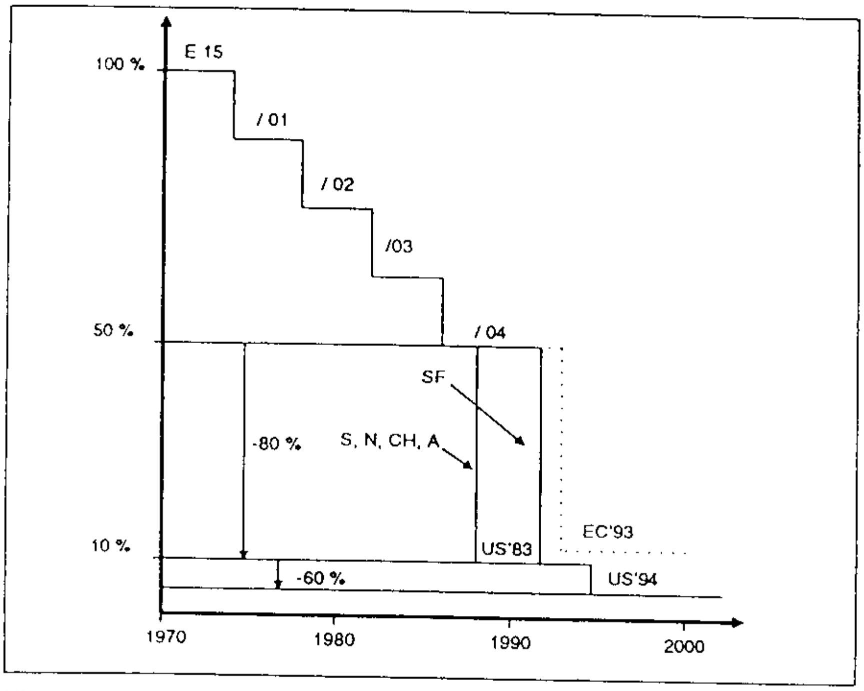
	CO	HC	NO_2	Part matter	SO_2	Pb	CO_2
	Tonnes						
Passenger cars	324 000	30 500	68 200	4 200	1 430	184	7 080 000
Vans	14 300	3 050	5 150	1 340	406	5	786 000
Buses, coaches	3 670	2 110	15 100	1 340	335	0	540 000
Lorries, road tractors	16 400	5 960	36 200	4 170	1 650	0	2 690 000
Road traffic, total[1]	**359 000**	**41 700**	**125 000**	**11 000**	**3 820**	**189**	**11 100 000**
Trains[2]	500	700	5 000	700	300	0	278 000
Ships[3]							
domestic traffic	300	300	5 900	200	2 500	0	306 000
Aircraft	2 000	500	1 100	50	50	0	321 000
Self-propelled industrial, agricultural and forest equipment	22 200	7 540	38 900	3 550	2 560	6	2 080 000
Inland traffic, total	**383 000**	**50 700**	**176 000**	**15 500**	**9 200**	**195**	**14 100 000**
Road traffic %	94	82	71	71	42	97	79
International waterway traffic[2]	200	200	38 800	100	18 000	0	–

1) For total emissions of volatile organic compounds in road traffic, see Table 3.
2) Includes electricity production.
3) The data on ships' nitrogen dioxide and sulphur dioxide emissions are derived from a Ministry of the Environment draft report.

4 Exhaust emission standards for vehicles

First exhaust emission limits for motor vehicles were introduced in 1970's, and they have been tightened several times in recent years (figure 4 and table 5).

Figure 4. Specific emissions of gasoline-fuelled passenger cars; relative developments in response to the revised emission standards (Source: Statistics Finland)



Like some other countries, Finland has switched from the prevailing European line to the more stringent US standard. The application of the US'83 limit was introduced in stages: on 1 January 1990 for all car models to be inspected and on 1 January 1992 for all new cars to be operated.

S = Sweden CH = Switzerland
N = Norway A = Austria

Table 5. Development of emission standards for heavy motor vehicles (Source: Statistics Finland)

Regulation	CO	HC	NO_x	Particulate matter
	g/kWh			
ECE R49				
1 Jan. 1989	14	3.5	18	ECE R24
ECE R49/01				
1 Jan. 1991	11.2	2.4	14.4	ECE R24
"EC'92"				
1 July 1992	4.5	1.1	8.0	0.36
"EC'95"				
1 Jan. 1995	4.0	1.1	7.0	0.15

Finland, as a new member of the European Union (EU), has started to apply the EC Directives as concerns the technical requirements and emission standards for vehicles. Council Directives 91/441/EEC, 93/59/EEC, 91/542/EEC and 94/12/EEC have been transposed into our national legislation. Vehicle emission standards are specified in the Decree on the Vehicle Construction and Equipment. The current standards are presented in table 6.

Table 6. Emission regulations in Finland 1.1.1995

Passenger cars			
1.1.1990	new models[1)]	CO..........2,1	g/km
1.1.1992	new vehicles[1)]	HC..........0,25	"
		NOx.........0,62	"
		part........0,37	"
		evap........2,0	g/test
1.1.1993	diesel cars[1)]	part........0,12	g/km
1.1.1996	new models	94/12/EC or E 83/01	
1.1.1997	new vehicles	94/12/EC or E 83/01	
Light commercial vehicles (vans)			
1.1.1992	new models	CO..........6,2	g/km
1.1.1993	new vehicles	HC..........0,5	"
		NOx.........1,1	"
		part........0,16	"
		evap........2,0	g/test
Heavy duty vehicles (lorries, busses)			
1.7.1992	new models[2,3)]	CO..........4,5	g/kWh
1.10.1993	new vehicles[2,3)]	HC..........1,1	g/kWh
		NOx.........8,0	g/kWh
		part........0,36	g/kWh
1.10.1995	new models[2)]	CO..........4,0	g/kWh
1.10.1996	new vehicles[2)]	HC..........1,1	g/kWh
		NOx.........7,0	g/kWh
		part........0,15	g/kWh

1) 91/441/EEC or E 83 accepted as from 1.1.1995
2) E 49/02 accepted
3) US'91 accepted until 1.10.1995/1.10.1996

Finland started to apply stringent US-standards for vehicles in 1990's. US'83 level standards for passenger cars became mandatory in 1992, and new particulate emission standards for diesel cars in 1993. Although all new petrol driven passenger cars today are equipped with catalytic converters the share of catalyst cars in passenger car fleet is still very low, only about 17 %.

New limit values for light commercial vehicles (vans) entered into force in 1992 for new models and in 1993 for all new registrations. The values correspond to the US'90 emission limits for light trucks.

Exhaust gas emissions from lorries and buses have been cut in line with the latest EC directives (Council Directive 91/542/EEC). In the first stage, in 1992-93, the emission limits of gaseous pollutants were reduced by 45-60 %, and the limit value for particulate emissions for heavy duty vehicles was introduced (see table 5). Vehicles that met the US'91 standards for heavy duty trucks were considered to comply with these requirements. In the second stage, in 1995-96, the reduction in the limit values will be 50-65 % if compared to ECE R 49/01 regulation.

Technical requirements to reduce energy consumption and carbon dioxide emissions have not been introduced. Standards or economic incentives to reduce the energy consumption of vehicles will have to be developed within international cooperation.

5 Fuels

5.1 Petrol

Lead and benzene content of petrol are regulated by Council of State Decisions. The maximum lead content for leaded petrol is 0,15 g/l and for unleaded 0,013 g/l. The maximum benzene content in petrol is 5 % by volume. Typical values are, however, considerably lower being for unleaded petrol less than 0,003 g/l lead, and less than 1 % benzene.

Unleaded petrol has been available since 1988. Because of effective use of tax incentives the market share of unleaded petrol is very close to 100 %.

Fuel quality effects vehicle emissions. In 1991 Neste Corporation brought into the Finnish market oxygen rich petrol which contained more oxygen (2.0 - 2.7 wt.-%) and less benzene (specification < 3 vol.-%, typical analysis < 2 vol.-%) than conventional petrol products at that time. The volatility of the new quality was also lowered to reduce evaporative emissions.

In April 1994 new reformulated petrol was introduced. Reformulated petrol contains less sulphur (< 0.01 wt.-%) and less benzene (< 1 vol.-%) than conventional or oxygenated petrol. It is unleaded, oxygen rich and it has low volatility. Reformulated petrol is expected to cut down carbon monoxide and hydrocarbon emissions by some 10-20 % in non-catalyst cars and evaporative emissions by approximately 15 %. Reformulated unleaded petrol can be used in cars that normally require leaded petrol. In a very short time the market share of reformulated qualities amounted to more than 90 %.

5.2 Diesel oil

The maximum sulphur content in diesel fuel is 0,2 % by weight. Typical values for gas oil, used in heating, and regular diesel oil, used in transport, are around 0,12 % (see also 3.2).

Apart from regular diesel oil, qualities with low sulphur content have become available. Low-sulphur diesel oil, also called reformulated diesel, contains less than 0,005 % sulphur. It first came into market in the southern parts of Finland in July 1993, and is now available all over the country. Its market share is around 60-70 %. Low-sulphur diesel oil cuts down sulphur emissions by 98 %, and is expected to reduce also particulate and nitrogen oxide emissions.

6 Economic incentives

Fuel taxation has the environmental aspect, apart from the fiscal one. Carbon tax was introduced in Finland in 1990 and the system has gradually been improved since then. As of the beginning of 1995, the tax based on carbon content has been FIM 38.30 per tonne of carbon dioxide, and the tax based on energy content FIM 3.50 per megawatt hour. Over the short term the impact of this type of tax is relatively slight, but because the new tax system is meant to be permanent, it already influences decisions on investments and will thus gradually affect the structure of production and consumption.

The Finnish tax on transport fuels is around the average West European level. At the moment, the tax on petrol is slightly below the EU average, and that on diesel oil just above the EU minimum, though well below the average. The tax on both fuels has been raised sharply in recent years, and this, together with the recession in the early 1990's, has halted growth in traffic volumes. The tax on petrol was raised, by over 10%, as of the beginning of 1995.

Economic incentives are applied to promote the use of unleaded, reformulated petrol qualities and low-sulphur diesel oil which are less harmful to the environment than conventional products.

Vehicle purchase tax and annual tax for diesel vehicles are levied, but these are clearly fiscal taxes. The Finnish tax on new cars is rather high by international standards. Tax relief on vehicle purchase tax has been granted since 1989 for passenger cars equipped with catalytic converters. Other kind of incentives to promote vehicle fleet renewal have not been used. The average age of passenger cars in Finland close to nine years.

Vehicle and fuel taxes and fees are considered to cover only part of the environmental costs of transport, although taxation in Finland is thought to be relatively high.

Other economic instruments adopted include subsidies for public transport (though these subsidies have had to be cut substantially in recent years), and investments in the rail network and in electrification. State funding has been granted to study the use of gas fuels, bioalcohols and rapeseed methyl esters in traffic. Road pricing or infrastructure tolls haven't sofar been introduced.

6.1 Environmental classification of fuel taxation

The excise duty on motor fuels, e.g. fuel tax, is scaled according to environmental properties. The tax differentiation of leaded and unleaded petrol was first introduced in 1986. As from the beginning of 1993 petrol and diesel oil have also been classified into standard and reformulated qualities.

The fuel tax on leaded petrol is some 20 % higher than on unleaded petrol (FIM/l 3,13 and FIM/l 2,68 respectively). Oxygen rich reformulated petrol gets an extra tax relief, which is FIM/l 0,05. The excise duty is near the average European level. Reformulated diesel gets a tax relief, which is FIM/l 0,15 (table 7).

Table 7. Petrol taxation in Finland 1.1.1995 (VAT not included)

Product	Fuel tax FIM/litre
leaded petrol	
- standard quality	3,18
- oxygen rich quality	3,13
unleaded	
- standard quality	2,73
- oxygen rich quality	2,68
diesel oil	
- standard quality	1,78
- low-sulphur quality	1,63

The share of all taxes (VAT etc. included) in petrol prices at the service station is approximately 70 %. Consumer prices vary considerably in different parts of the country and even within the same region. In February 1995 the average prices for unleaded petrol were FIM/l 4,97 (95 oct) and FIM/l 5,10 (98 oct), and for diesel FIM/l 3,70 (Source: Finnish Petroleum Federation).

7 In-use vehicle testing

Annual emission inspections of in-use passenger cars began in 1993. The test includes carbon monoxide and hydrocarbon control and a lambda value test. Limit values are presented in table 8. Particulate emission tests for diesel cars started in January 1995. The emissions of diesel cars have to comply with the requirements of the Council Directive 92/55/EEC.

Petrol driven cars registered before 1978, diesel cars registered before 1980, and two-stroke engines are exempted from the test. About 10-15 % of all passenger cars tested for the first time have failed to pass the test, and have to undergo adjustments and repairs.

Emission testing may be conducted by vehicle inspection offices or by commercial garages and service stations. Motor Vehicle Administration is in charge of controlling and supervising the testing.

Table 8. In-use vehicle testing limit values

	idling		high idle speed (2000 rpm)		
	CO %	HC ppm	CO %	HC ppm	lambda
Vehicles put into service					
* before 1.10.1996	4,5	1000	-	-	-
* 1.10.1986 or after	3,5	600	-	-	-
TWC's	0,5	100	0,3	100	1±0,003

Apart from annual emission testing of in-use cars, durability requirement checks of emission control device have been carried out since 1994. This means that competent authorities may require remedial plans from the manufacturer if the vehicles selected for the test do not comply with durability requirements.

8 Land use and physical planning

Many of the problems of today have their roots in the recent history. The spatial structure in Finland has changed rapidly since 1940's when there was significant migration from rural to urban areas. The structure of a Finnish town is rather dispersed with satellite housing districts in urban fringe areas. Long distances between cities, homes, jobs and services consume human, financial and material resources.

Ministry of the Environment is in charge of national, regional, and certain local land use planning issues, urban policy, community structure and nature conservation. Spatial planning is an important element in programmes concerning regional development, urban corridors, transport networks etc.

The present main objectives are balancing spatial development, reducing urban sprawl and improving urban living environments. As far as possible, railways, public transport, pedestrian traffic and cycling will be promoted in land use and community planning.

This objective will be intensified by the new Building and Planning Act.

Environmental Impact Assessment (EIA) legislation was introduced in 1994. Land use planning and EIA were integrated in the last review of the Building and Planning Act. Already now EIA is extended to all major transport projects (motorways, ports and airports).

9 Environmental Programme for Transport

The Ministry of Transport and Communications established in October 1994 a comprehensive environmental programme for the transport sector. The programme specifies the objectives for reducing the environmentally harmful impacts of traffic by the year 2000 and the action required to meet these objectives. The programme includes 76 measures, both technical, economical and structural.

The programme is organized along problem areas: greenhouse gases and other air pollutants, urban air quality, noise, waste management, protection of water resources and ground water, assessment of environmental impacts, environmental awareness, research and monitoring. The programme also deals shortly with land use and physical planning.

The main targets for year 2000 are:

- freezing the climate gases from transport to 1990 level,
- reducing NOx emissions by 30 % from the level of 1980,
- reducing VOC emissions by 50 % from the level of 1988,
- improving ambient air quality in urban areas,
- recycling vehicle parts and scrap,
- reducing noise of traffic and
- implementing EIA in plans and projects.

The bodies responsible for implementing the programme are the Ministry of Transport and Communications and its subordinate agencies and public enterprises, the other ministries, local authorities, companies and organizations. Much of the programme is on a voluntary basis.

To ensure that traffic systems develop in a sustainable manner, it is proposed that traffic growth should be restrained through socially acceptable structural and financial means. The programme recommends that the necessary transportation should be provided efficiently and economically, while involving the minimal amount of traffic.

Most of the measures in the programme concern road traffic, because its environmental impact is on the whole more controllable than with other forms of transport. However, action is also proposed to reduce the environmental impact of rail, water and air traffic, and working machinery.

10 Future trends

Detrimental effects of traffic have accentuated during the last decade. The growth of traffic, extensive infrastructure plans and projects, and problems associated with built-up areas have commenced a need to restrain traffic. The measures to reduce the harmful effects from traffic can be divided into four categories, which are:

- technical improvements,
- modal split,
- physical planningand EIA,
- economic instruments.

With regard to technical requirements, the development in the European Union is important to Finland. EU has recently made progress in its emission policy and, as a result, new limit values for light duty and heavy duty vehicles will enter into force in 1996-1997 and 1995-1996 respectively. Emission requirements for year 2000 are also on their way.

The need for further restrictions for vehicle emissions is clear. This need as well as emissions from working machinery, diesel locomotives, ships and aeroplanes will have to be dealt with in international cooperation.

In Finland the environmental quality of conventional motor fuels has improved considerably since 1980's. The use of alternative gas fuels, alcohols and rapeseed methyl esters has been studied, and gas powered lorries and buses have been developed as far as the production stage. As from now, possibilities to promote the use of alternative fuels have to be addressed carefully.

Another important issue is the energy efficiency of transport. Average fuel consumption of new vehicles has to be lowered. This is, to a great extent, technically possible but manufacturers and customers are unwilling to produce and buy such cars. Necessary measures to promote the sale of low-consumption cars will have to be worked out, together with possible taxation practices promoting the use of environmentally more acceptable cars.

In the long run, there is always the possibility that the growth of traffic will overweight the benefits of technical improvements. If necessary, increase of traffic should be restricted by policy measures, better use of communication and information systems, economic instruments and land use planning.

The operating potential of public transport and rail traffic is to be improved by enhancing the price and service competitiveness of these modes. Electrification of rail traffic will continue, and the network will be improved. In transit traffic through Finland into Russia, efforts will be made to make the railways more competitive, e.g. by adjusting freight rates.

Physical planning should, among other things, facilitate environmentally friendly modal split, and greater use of public transport, cycling and walking. New housing areas will, as far as possible, be located in the areas best placed in terms of public transport services. Pedestrian and cycle paths in town centres will be increased and parking arrangements planned so as to reduce traffic. In peripheral areas, however, the use of private cars is most likely to remain the most prominent transport mode.

Cooperation between environmental, transport, physical planning and economic operators in the preparation of environmental strategies and plans for the transport sector is essential. One of the most important tasks in the future is to ensure that this cooperation will be continued and developed further.

Appendix 1

Information about transport in Finland (the figures are given for year 1993 unless expressed otherwise)

Infrastructure

- public roads	78 000 km
motorways	337 km
motor traffic roads	221 km
- rail roads total	5 864 km
electrified	1 256 km
- underground railway lines	17 km
- tramway	70 km
- ports with merchant shipping (-92)	45
- airports with scheduled services (-92)	25

Automobiles

- passenger cars	1 872 900
- vans (< 3 500 kg)	207 700
- lorries, trailers	45 500
- busses	8 300
- others	21 700

New registrations (passenger cars)

- in 1993	56 000
- in 1989	180 000
- average in 80's	137 000

Passenger car density (cars/1000 inhabitants)

- in 1990	389
- in 1993	366

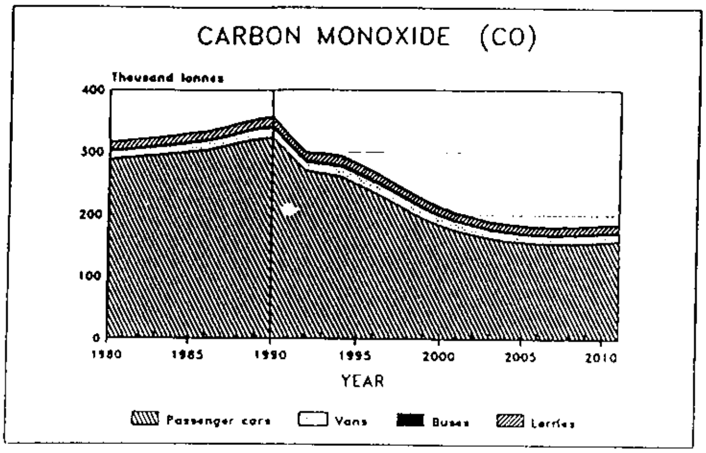
Domestic passenger transport performance (mill. passenger-km)

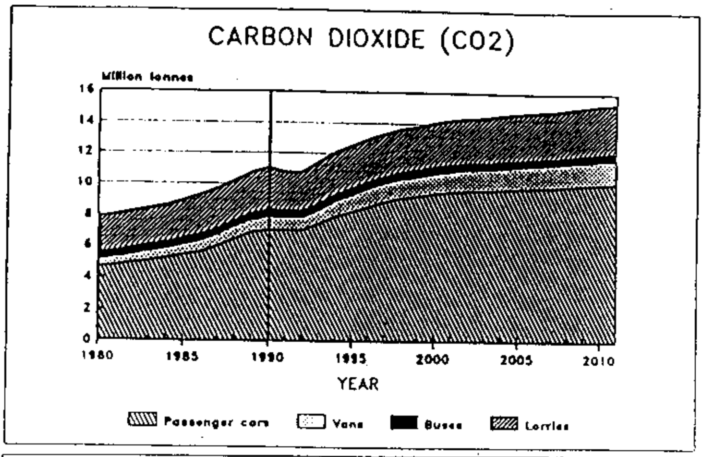
- passenger car	49 900
- bus, underground	8 357
- railway	3 007
- air	818
- water	100

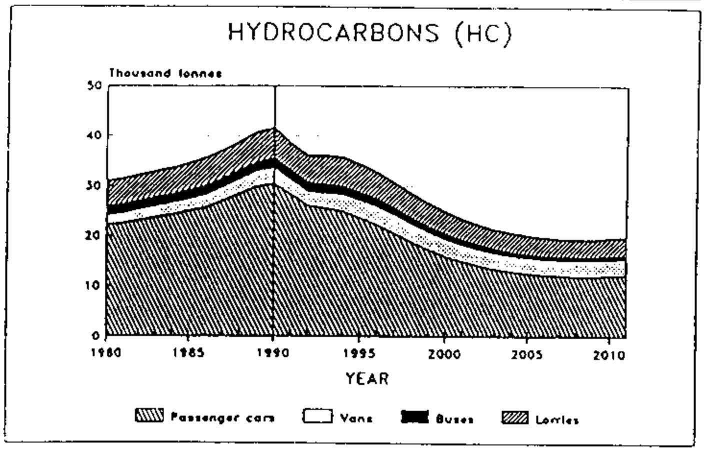
Domestic goods transport performance (mill. ton-km)

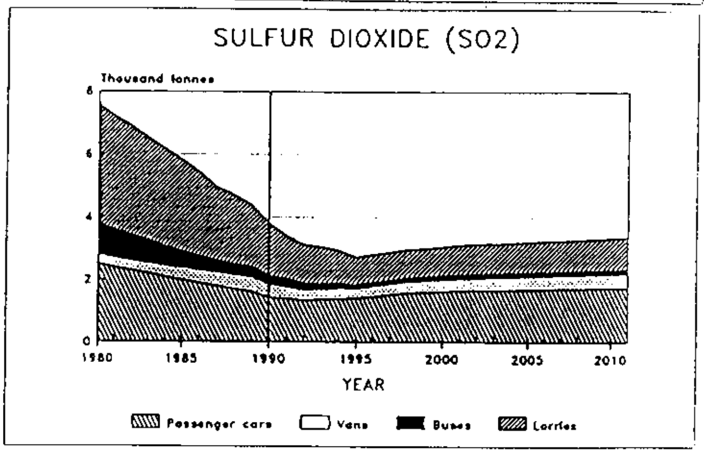
- road transport	25 000
- railway transport	9 259
- water transport	3 029

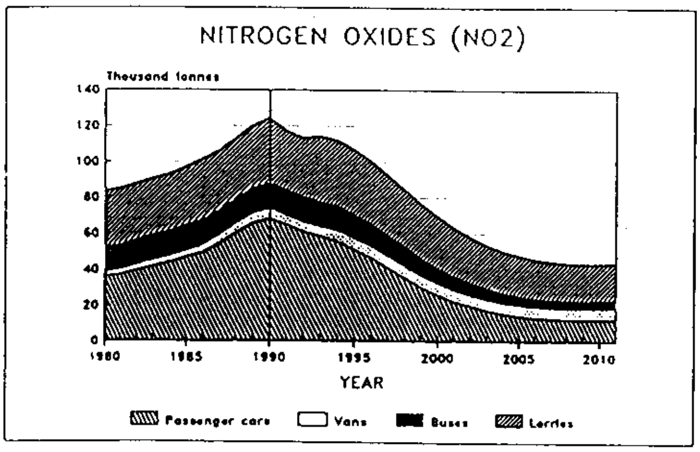
Road traffic emissions: estimated amounts in 1980-2010 with 1990 as the base year

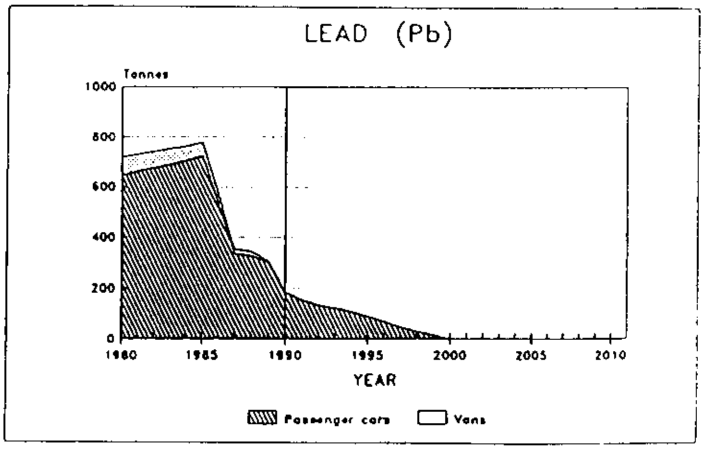












Source: Technical Research Centre of Finland: Road, Traffic and Geotechnical Laboratory

Transport and Environment in Germany

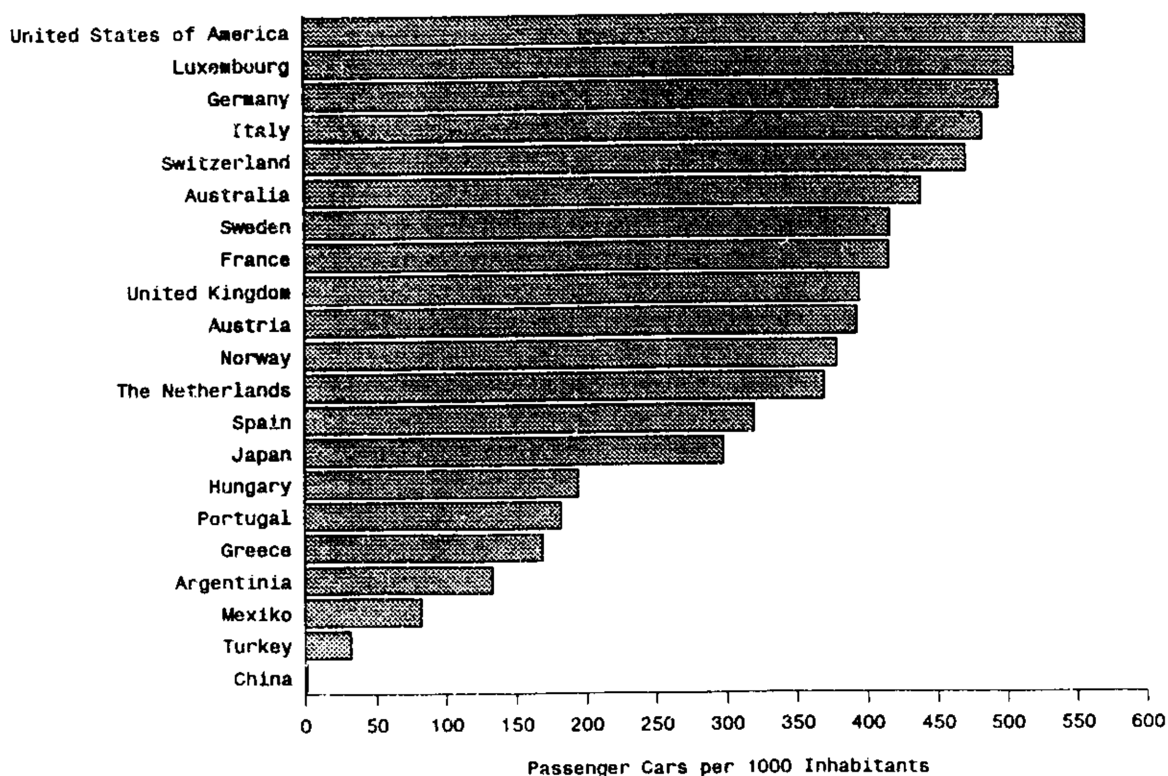
Norbert Gorißen, Federal Environmental Agency, Berlin

Paper presented at the Workshop on the Reduction of Emissions from Traffic in the Baltic Area, Rostock-Warnemünde, 1995-01-24

1. Trends in Transport Development

Germany has one of the highest motorization rates in the world. more than 450 passenger cars per 1000 inhabitants are registered (unified Germany), compared to less than 200 in the countries in transition (figure 1). Prognosis of the passenger car stock in the past have promised since the early seventies a soon period of satisfaction, which always was overtaken by reality. Recent studies promise a passenger car stock of 37 to 43 Mio passenger cars in 2010 for West Germany, while the actual number for 1995 is 33 Mio (figure 2).

Motorization Rates in Different Countries 1992



Refernce: German Car Manufacturers Association

Figure 1:

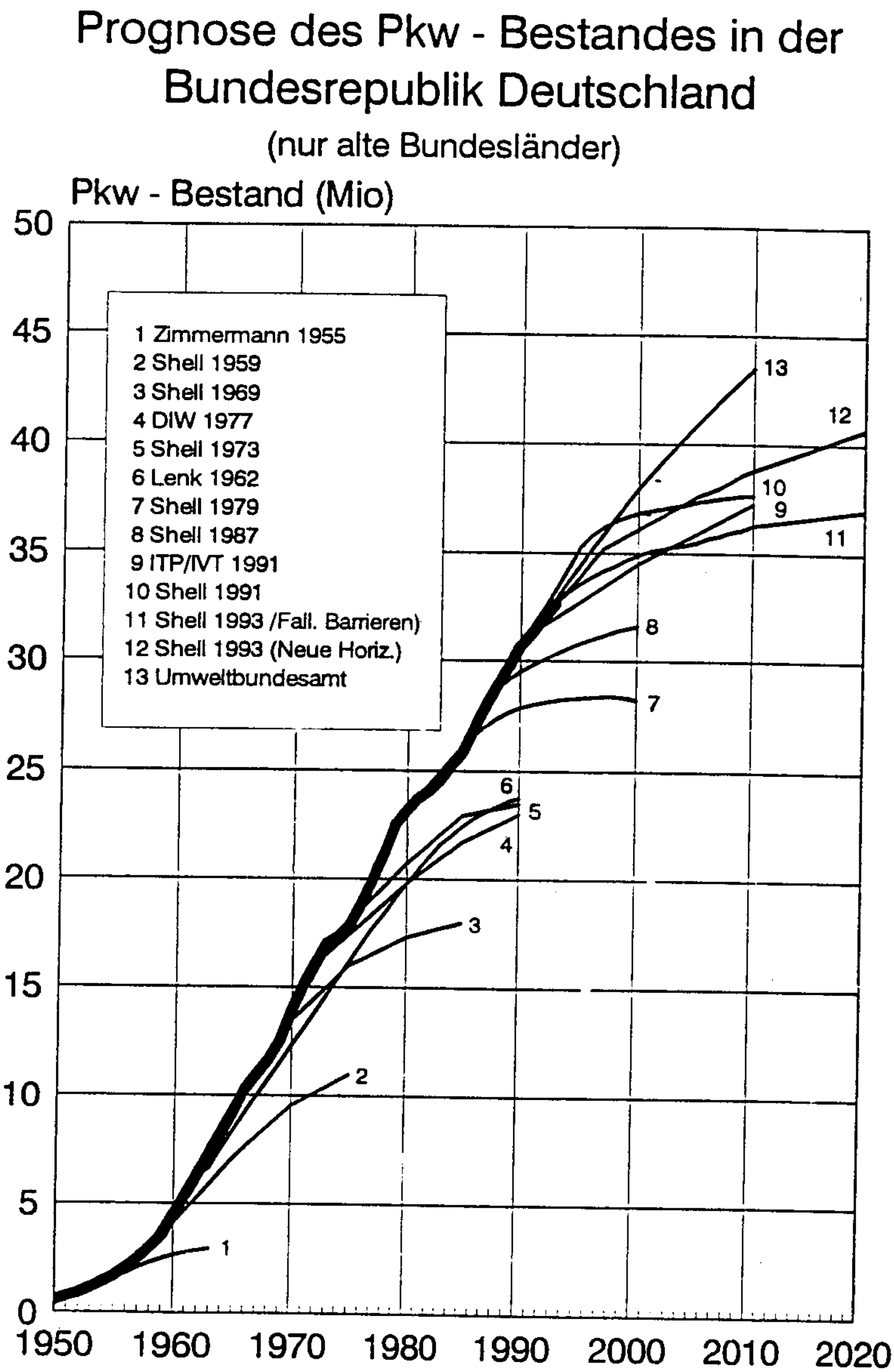


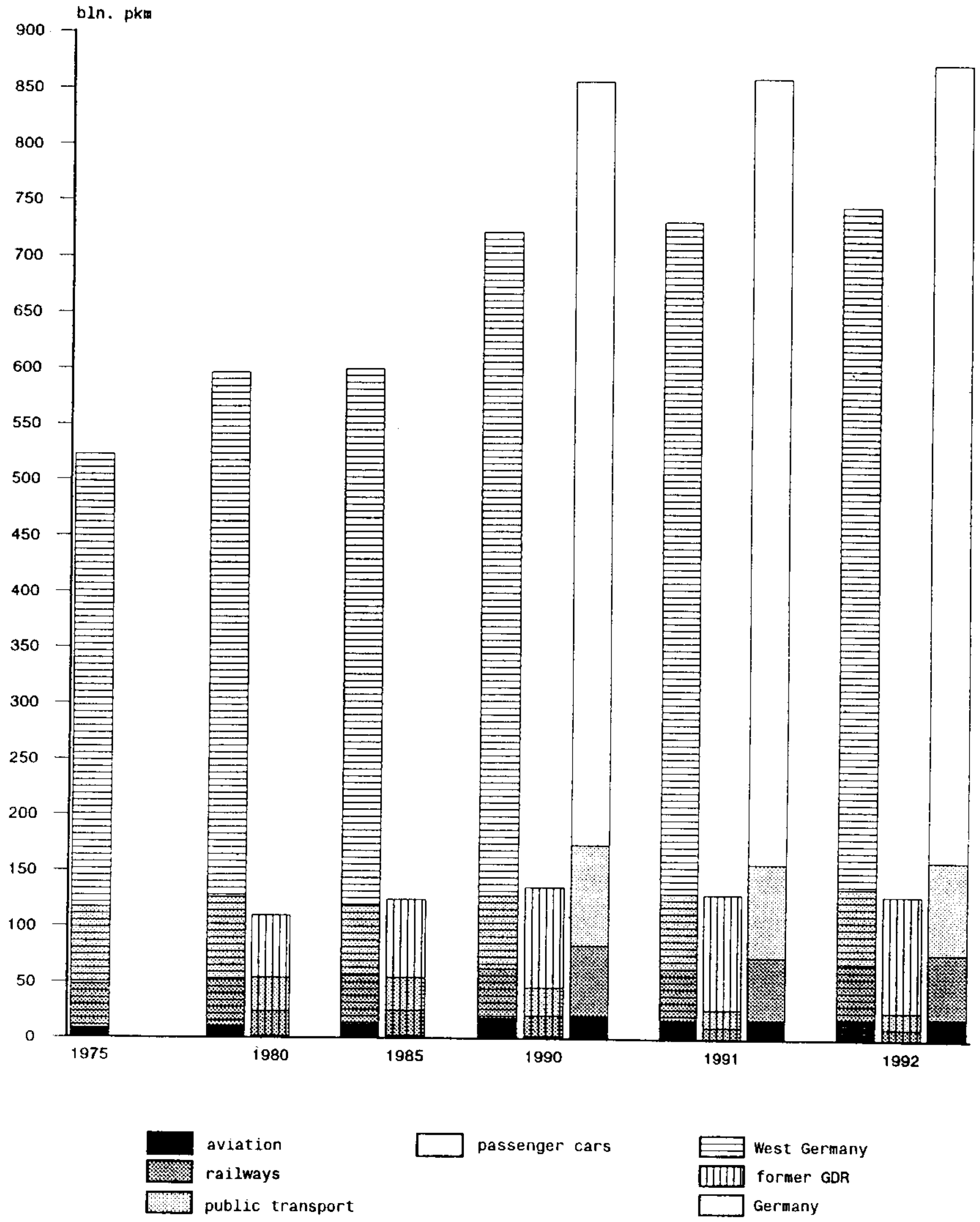
Figure 2: Prognosis of Passenger Car Stock in West Germany

Passengerkilometers in Germany have developed respectively; growth rates were dominated by individual car traffic and aviation, while railways and public transport stayed more or less constantly. In the former GDR there was a very dramatic increase of passenger car traffic, while public transport decreased sharply after the unification (figure 3). Similar are the trends of freight transport. The increase of tonnekilometers between 1975 and 1992 in West Germany was about 50%, road haulage participated outstanding. in the former GDR after the unification rail freight transport was cut to a third, while it stayed constantly in West Germany (figure 4).

Prognosis of the future freight transport show a continuation of the trend combined with a little progress of rail transport. But the data of the recent years are not compatible with these promises (figure 5).

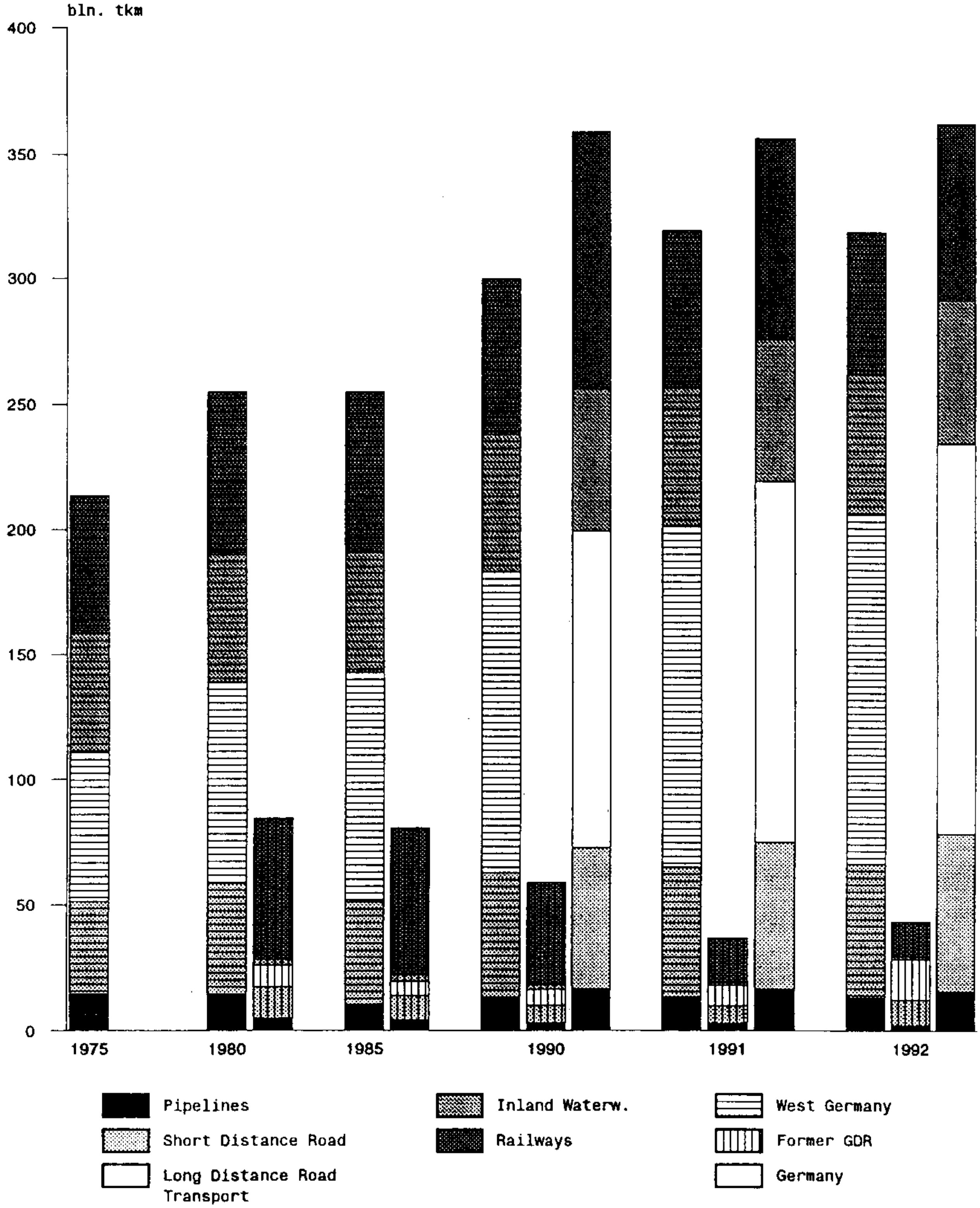
One of the foundations of the transportation policy in Germany is the assumption, that the growth of traffic is a main prerequisite for economic growth. Analysis show, that during the last 20 years there was a lower growth rate of the economy, than of tonnekilometers. This is an important aspect for discussing measures for a sustainable transport policy. It is remarkable that this analysis was done by the German road hauliers association (BDF) (figure 6).

Figure 3:Passengerkilometers in Germany 1975-1992



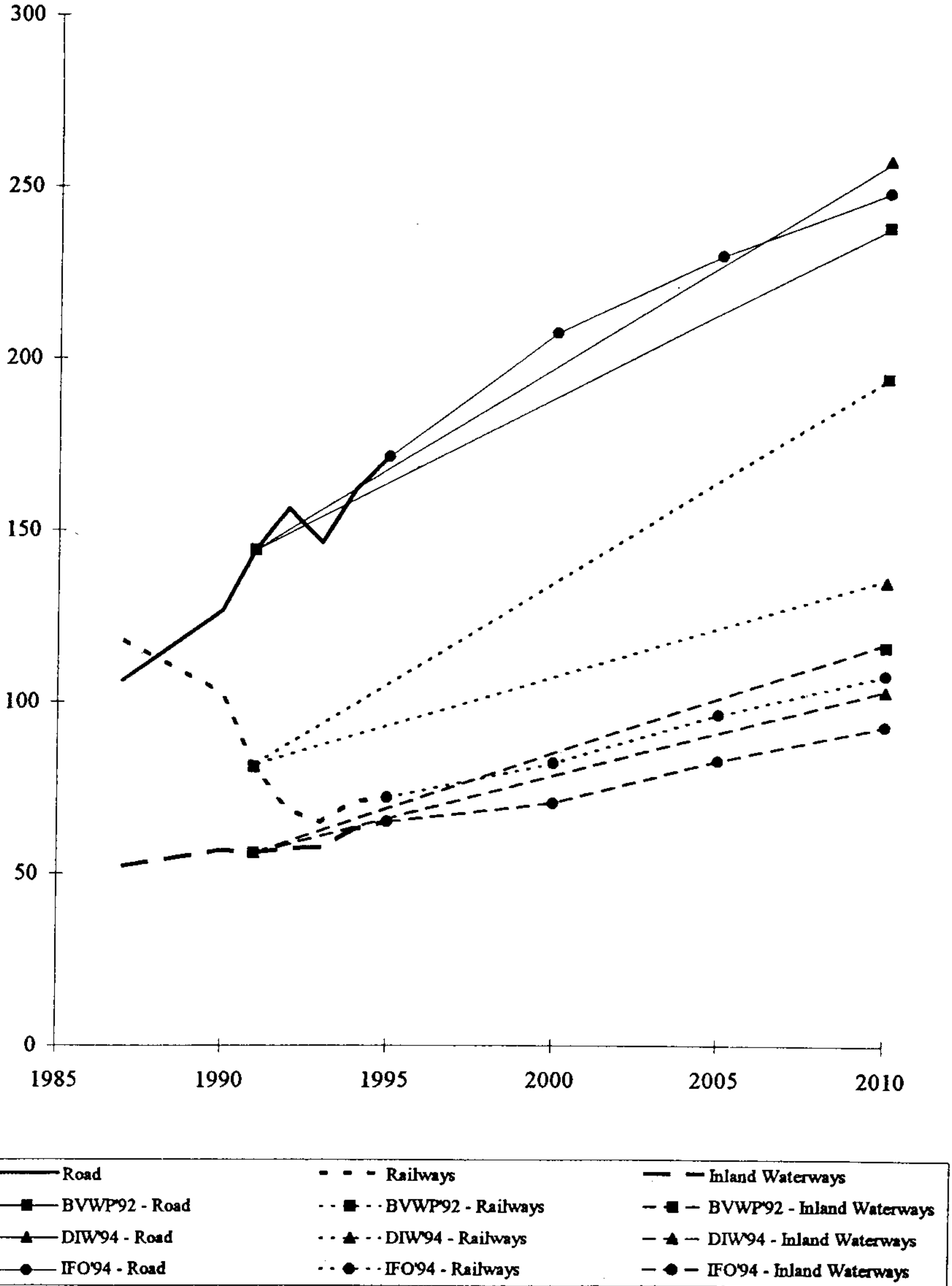
Reference:Federal Ministry of Transport

Figure 4: Freight Transport in Germany



Reference: Federal Ministry of Transport

Figure 5 : Freight Transport Prognosis (Germany)



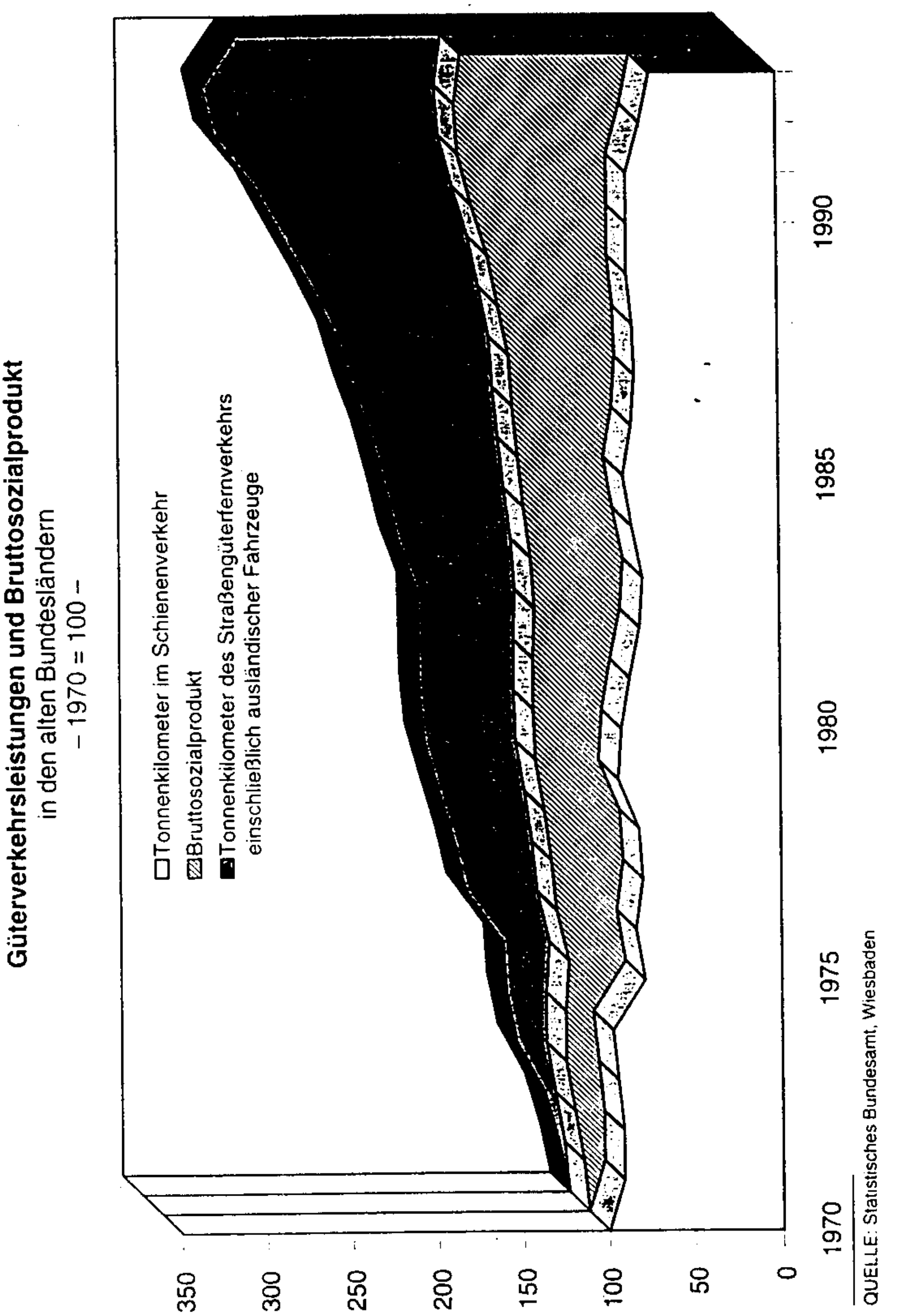
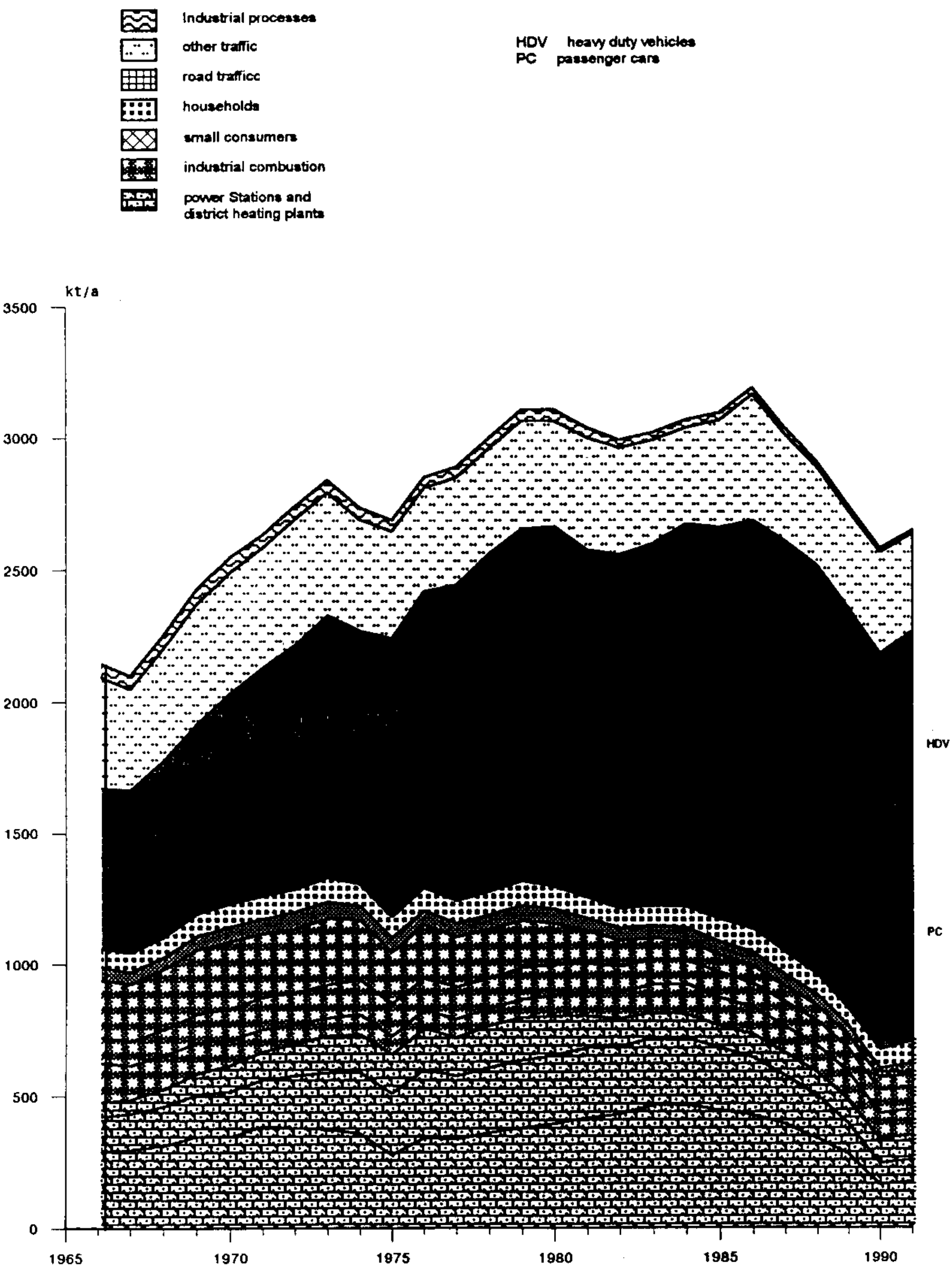


Figure 6: Normalized Tonnekilometers and Economic Growth in West Germany (dark above: road transport, dark bottom: railways, bright: GDP)

2. Trends of Air Pollutant Emissions in Germany

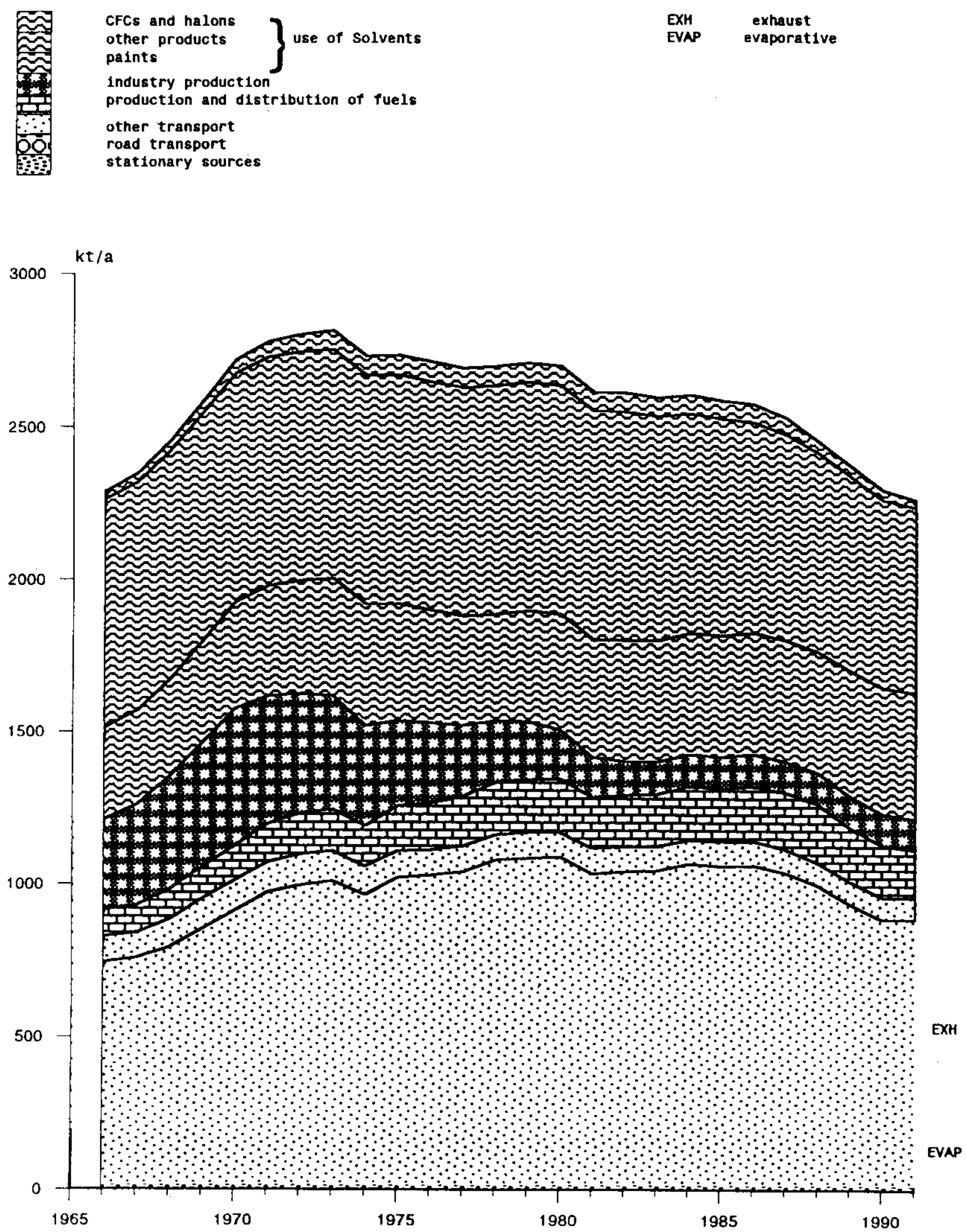
The Baltic Sea is seriously affected by air pollutant emissions like nitrogen oxides (NO_x) and volatile organic compounds (VOC). The transport sector is contributing a more and more important part of the total NO_x- and VOC-emissions in Germany. From 1966 to 1986 the total NO_x-emissions in Germany increased from 1,95 Mio t/a to 3,2 Mio t/a. Due to the measures, which were taken at power stations, the total NO_x-emissions decreased in the last years, while the transport sector still was increasing. Now the transport sector is responsible for two thirds of the total NO_x-emissions, that is 1,9 Mio t/a. A decrease of the transport NO_x-emissions has just started (see figure 7). In East Germany the NO_x-emissions of the transport sector are increasing following the high traffic growth rates, while other sectors decrease.
As well the VOC-emissions are mainly dominated by the transport sector. Nearly a half of the total VOC-emissions in West Germany (1,2 Mio t/a) are originated by transport, most of them coming from the exhaust of gasoline passenger cars and from evaporative processes in the tank and fuel system of gasoline passenger cars. Since the middle of the eighties the VOC emissions are decreasing, especially the transport related emissions (figure 8). In East Germany the transport share to VOC-emissions was even higher, due to the high amount of two-stroke-vehicles.

Figure 7: Nitrogen emissions in West Germany - 1966 - 1991



Refernce: Federal Environmental Agency

Figure 8: Emissions of volatile organic compounds(VOC) in West Germany 1966 -1991



Refernce: Federal Environmental Agency

The development of road traffic growth in West Germany and the subsequent air pollutant emissions is shown in figure 9 and 10. Passenger car mileage is responsible for 90% of the mileage of the total road traffic and it doubled between 1970 and 1992. Since the eighties diesel passenger cars became more important and 1985 the introduction of catalysts supported by tax incentives started. 1992 only half of the total passenger car mileage was driven with conventional gasoline cars, but this was still more than the total passenger car mileage of 1970. The road traffic related CO_2.-emissions developed similarly to the mileage, but underlining the important role of heavy duty vehicles, although they have only a little mileage share (figure 9). Hydrocarbon emissions of road traffic are dominated by gasoline passenger cars, but the part of motorcycles is not neglectable. The exhaust regulations of the ECE and the European Union since the early eighties had an reducing influence on the growth of hydrocarbon emissions of road traffic. Starting 1986, after the introduction of the catalysts the total amount of hydrocarbon emissions from road traffic decreased. The NO_X-emissions of road traffic in West Germany were increasing steadily until 1987, when a slight decrease started. The gasoline passenger cars now do not play any more the dominant role, since the introduction of the catalyst reduced their emissions despite of the mileage growth. But this reduction was compensated by an high increase of heavy duty vehicles NO_X-emissions (figure 10).

Figure 9:

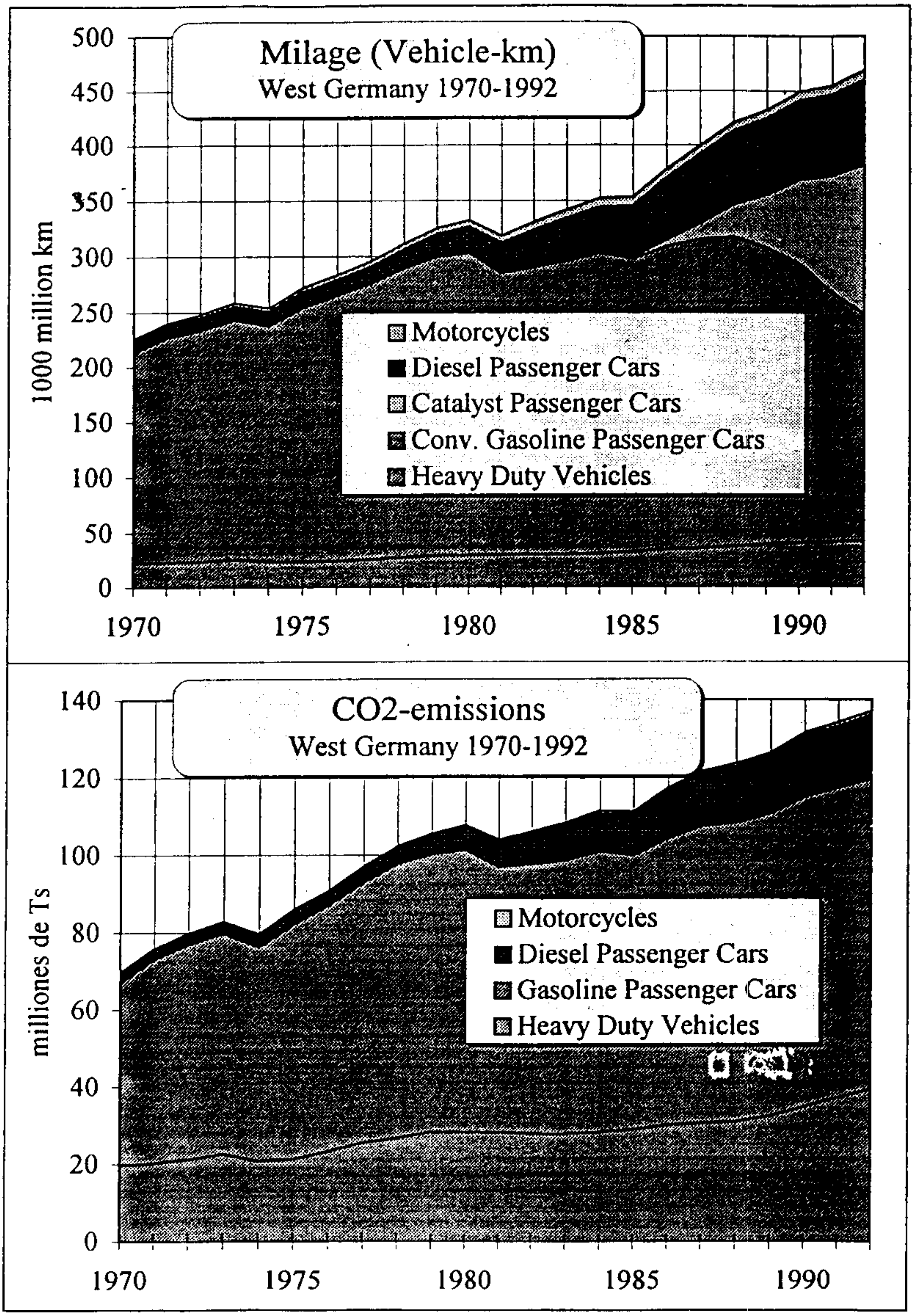

Milage (Vehicle-km)
West Germany 1970-1992
500
450
400
350
300
250
200
150
100
50
0
1000 million km
Motorcycles
Diesel Passenger Cars
Catalyst Passenger Cars
Conv. Gasoline Passenger Cars
Heavy Duty Vehicles
1970
1975
1980
1985
1990
CO2-emissions
West Germany 1970-1992
140
120
100
80
60
40
20
0
milliones de Ts
Motorcycles
Diesel Passenger Cars
Gasoline Passenger Cars
Heavy Duty Vehicles
1970
1975
1980
1985
1990

Figure 10:

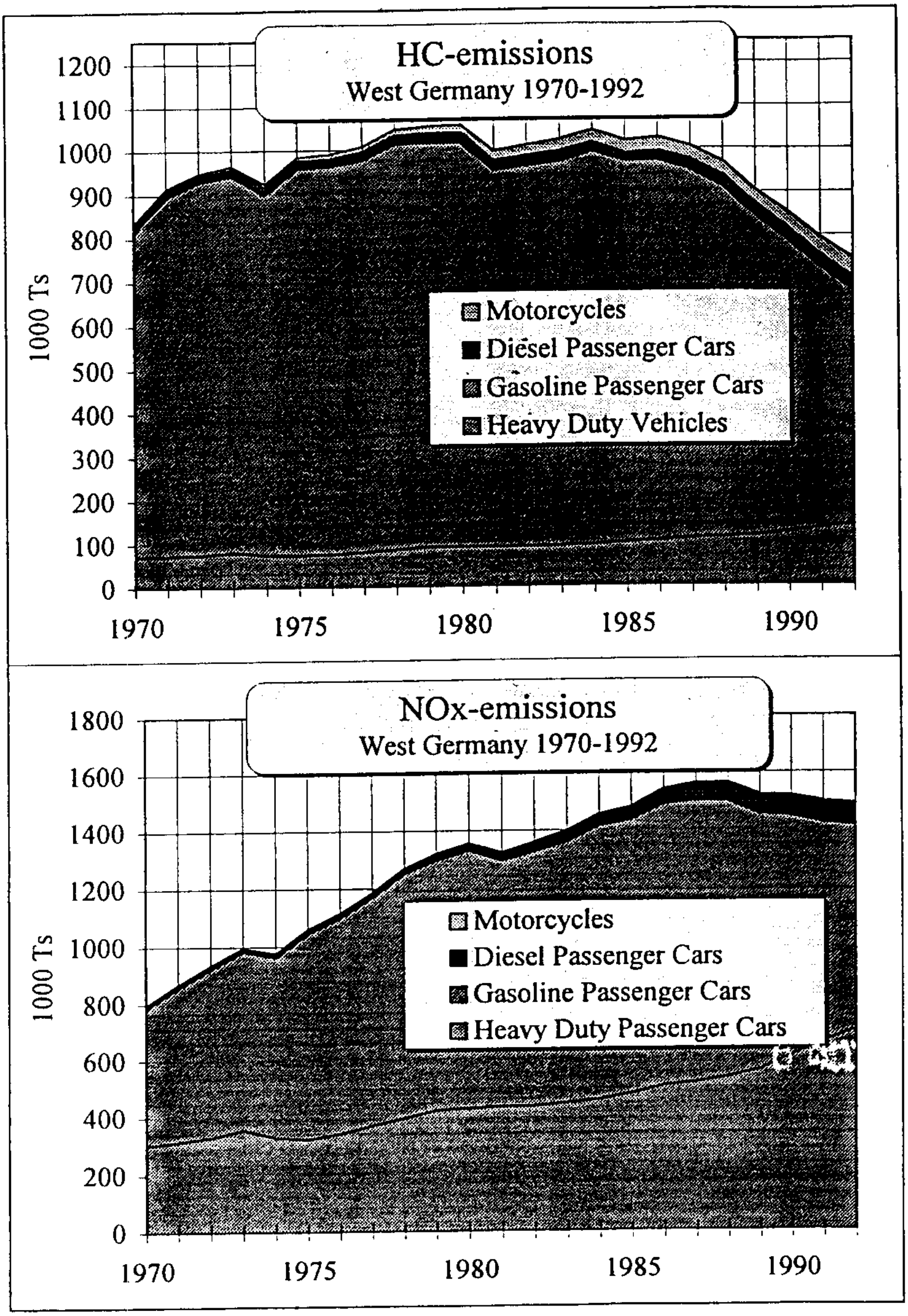

HC-emissions
West Germany 1970-1992
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1000 Ts
1970
1975
1980
1985
1990
Motorcycles
Diesel Passenger Cars
Gasoline Passenger Cars
Heavy Duty Vehicles
NOx-emissions
West Germany 1970-1992
1800
1600
1400
1200
1000
800
600
400
200
0
1000 Ts
1970
1975
1980
1985
1990
Motorcycles
Diesel Passenger Cars
Gasoline Passenger Cars
Heavy Duty Passenger Cars

Table 1 gives a detailed overview on emissions from road transport in Germany for the years 1990, 1991 and 1992.

(Figures rounded)		1990		1991		1992	
		Cars	Utility vehicles[1)]	Cars	Utility vehicles[1)]	Cars	Utility vehicles[1)]
Carbon monoxide	G	5 551,0	219,0	5 119,0	237,0	4 834,0	247,0
in thousand tonnes	OL	4 622,0	155,0	4 177,0	165,0	3 857,0	175,0
	NL	929,0	64,0	942,0	72,0	977,0	72,0
Non-methane volatile	G	1 022,0	148,0	952,0	164,0	888,0	171,0
organic compounds	OL	652,0	120,0	579,0	128,0	520,0	135,0
in thousand tonnes	NL	370,0	28,0	373,0	35,0	368,0	35,0
incl. **Benzene**	G	46,0	3,0	43,0	3,0	41,0	3,0
in thousand tonnes	OL	40,0	2,0	37,0	2,0	34,0	2,0
	NL	6,0	1,0	6,0	1,0	7,0	1,0
Methane	G	67,0	3,0	72,0	4,0	77,0	4,0
in thousand tonnes	OL	43,0	2,0	45,0	3,0	45,0	3,0
	NL	24,0	1,0	27,0	1,0	32,0	1,0
Nitrogen oxides	G	978,0	677,0	905,0	732,0	861,0	778,0
(as NO_2)	OL	910,0	608,0	839,0	658,0	790,0	699,0
in thousand tonnes	NL	68,0	69,0	66,0	74,0	71,0	79,0
Carbon dioxide	G	108,4	40,4	109,0	43,1	110,3	45,5
in million tonnes	OL	96,2	34,6	96,2	37,1	96,7	39,3
	NL	12,2	5,8	12,7	6,0	13,6	6,1
Diesel particulate matter	G	-	58,0	-	59,0	16,0	60,0
in thousand tonnes	OL	15,0	42,0	15,0	43,0	15,0	44,0
	NL	-	16,0	-	16,0	1,0	17,0

1) Utility vehicles: HGVs and buses

Source: Umweltbundesamt, 1994 G = Germany OL = old „Länder" N = new „Länder"

Table 1: Emissions from Road Traffic in Germany 1990 - 1992

This traffic growth and the subsequent emissions cause serious air quality problems in city roads. Table 2 shows results of recent measurements. The values of carcinogenic components like benzene and soot are subject of serious concern.

Pollutant average		annual	98 percentile	max. 1/2 h
CO	mg/m^3	1 - 4	3 - 10	10 - 30
NO_2	µg/m^3	30 - 100	80 - 150	190 - 380
NO	µg/m^3	40 - 170	200 - 600	800 - 1700
benzene	µg/m^3	10 - 40	(30 - 50)	(60 - 100)
O_3	µg/m^3	30 - 50	100 - 170	180 - 290
soot	mg/m^3	3 - 12		
TSP	µg/m^3	50 - 80	100 - 180	220 - 550
Pb	ng/m^3	80 - 170	160	240
Cd	ng/m^3	1 - 1.6		
NMHC	µg/m^3	80 - 1200	650 - 2200	2700 - 5500

Table 2: Range of air pollution concentration values from city streets

3. Emission Reduction Targets and Forecasts for the Transport Sector in Germany

There are a number of politically agreed emission reduction targets, which have considerable influence on the transport sector , or are directly orientated to the transport sector. Table 3 gives an overview on these targets.

1. ECE-Protocols (Convention on Long Range Transboundary Air Pollution):

NO_x: Additional declaration to the Sofia-protocol 1988
-30% from 1985 to 1998 (all sources);

VOC: Protocol of 1991
-30% from 1989 to 1999 (all sources);
Germany heads for a -50% reduction;

2. Helsinki Commission Baltic Marine Environment Protection Commission (HELCOM):

N: Reduction of N-input to the Baltic sea, concluded at the 1992-meeting: -50%

3. Climate Protection:

CO_2: a)Federal German Government decisions of the 1990-06-13, 1990-11-07, 1991-12-11 and 1994-09-29:
-25% to -30% from 1987 to 2005 (orientating values for all sources);
Speech of the German Chancellor Helmut Kohl at the Climate Summit in Berlin 1995-04-05:
-25% from 1990 to 2005 (for all sources)

b)European Union Council declarations of 1990-10-29:
"stand still" from 1990 to 2000;

c)Decision of the Conference of the Transport Ministers of the German Länder from October 1991:
-10% from 1987 to 2005 (only transport sector);

d)Recommendations of the Enquete Commission of the 11th German Bundestag „Preventive Measures to Protect the Earth's Atmosphere" from October 1990:
from 1987 to 2005 (all sources, but with a substantial share of the transport sector):

CO_2:	-30%
CH_4:	-30 %
NO_x:	-50 %
CO:	-60 %
NMVOC:	-80 %

4. Decisions of the Conference of the Environment Ministers of the German Länder November 1990:

Reduction targets for the transport sector from 1987

	to 1998:	to 2005:
NO_x:	-30%	-60%
HC:	-50%	-70%
CO_2:	-5%	-10%

Table 3: Emission Reduction Targets for the Transport Sector

In the case of the protection of the environmental protection of the Baltic marine especially the reduction targets on NO_x, VOC and N are of interest for the transport sector. These emission reduction targets can only be met, if the transport sector reduces its emissions significantly. Up to today there are only a few transport related emission targets. One example are the emission targets set by the Conference of Environment Ministers of the German Länder (see table 3). The future trend of transport emissions is shown in figure 11 for NO_x, HC and CO_2. Compared to 1987, the basis year for the emission prognosis, a 35%-reduction of NO_x-, a 75%-reduction of HC- and a 40%-growth of CO_2-emission is to be expected. Compared to the emission targets set by the Conference of the Environment Ministers of the German Länder this is only for HC-emissions satisfying. It is not sure, that the N-reduction target of HELCOM will be met.

The Federal Environmental Agency in the meantime is working out a plan for a sustainable mobility in Germany, which will include a number of environmental targets for the transport sector, e.g. for CO_2, carcinogenic compounds, ozone, NO_x, VOC, noise, waste, natural stock and landscape and living conditions in towns.

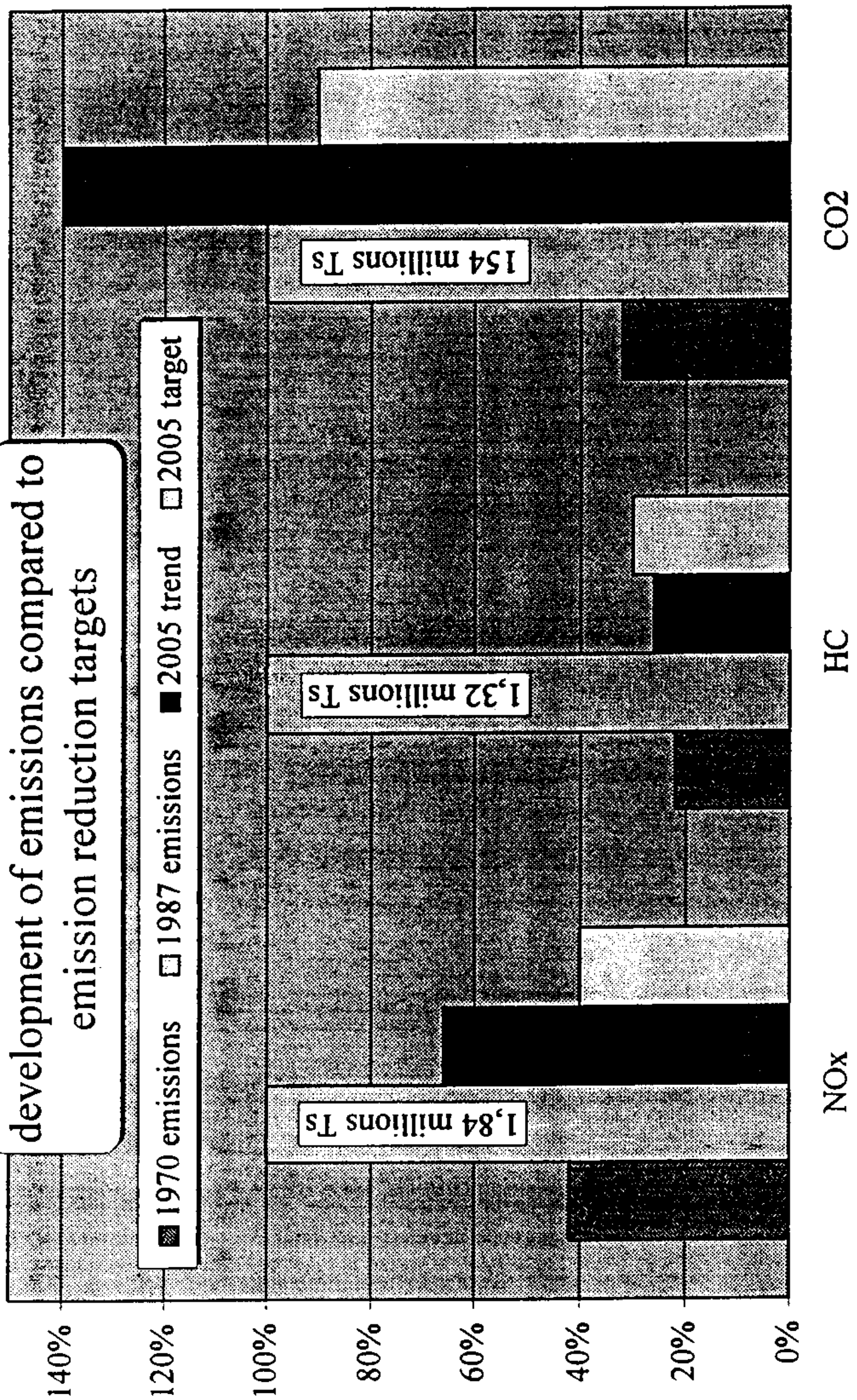

development of emissions compared to emission reduction targets
1970 emissions
1987 emissions
2005 trend
2005 target
1,84 millions Ts
1,32 millions Ts
154 millions Ts
NOx
HC
CO2
140%
120%
100%
80%
60%
40%
20%
0%

Figure 11:

4. Measures to Control Environmental Impact of Transport

The reduction of environmental impact should follow the later principles:

- First of all transport should be avoided, if not necessary, e.g. by an intelligent spatial planning or through correct prices for transport.
- Secondly transport should be shifted, as far as possible, to more environmentally friendly transport modes, e.g. public transport, railways, inland waterways, bicycles.
- Thirdly motorized vehicles should be equipped with the best available technologies (BAT) to reduce their emissions, e.g. catalysts, soot traps, noise shields.
- Last but not least transport should be performed in an environmentally friendly mean (driving patterns) and transport infrastructure should be kept as small as possible in a manner, that takes care of the nature and landscape (BEP).

4.1 Technical Measures to Control Exhaust Gas Emissions of Vehicles

Figure 12 and 13 demonstrate the exhaust gas emission reductions achievable with three-way-catalyst cars compared to two-stroke cars, conventional gasoline cars, open-loop catalysts and diesel cars. These values are measured emissions from in-use vehicles on different road types with their subsequent driving patterns. The three-way-catalyst provides in practise the lowest emission values - a 80% reduction compared to conventional gasoline cars - and it is forced to be implemented in all new gasoline passenger cars in the European Union following the regulation 91/441/EEC.

Figure 12: NOx-Emission Factors for Passenger Cars

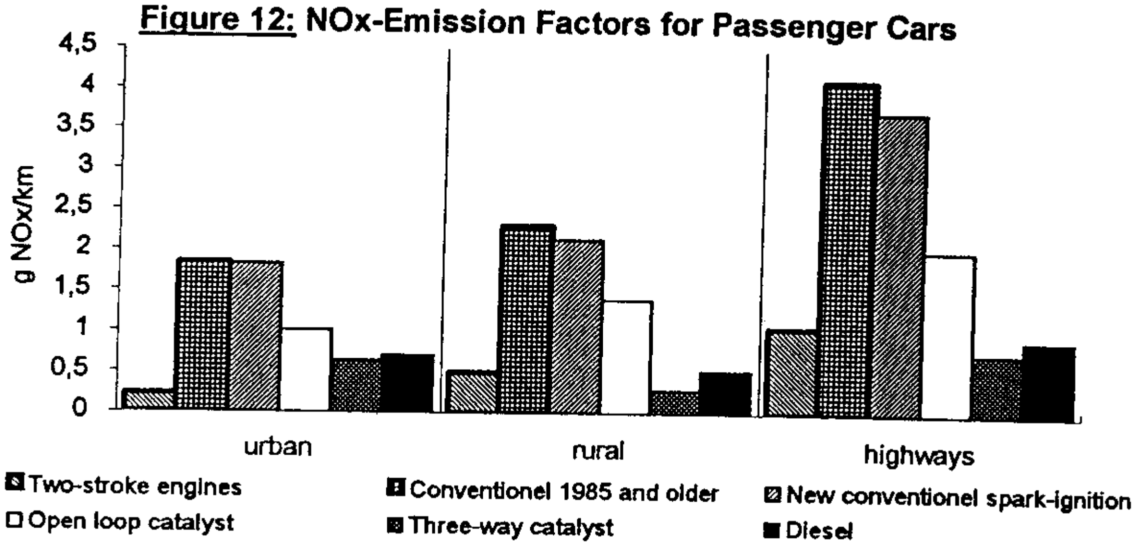
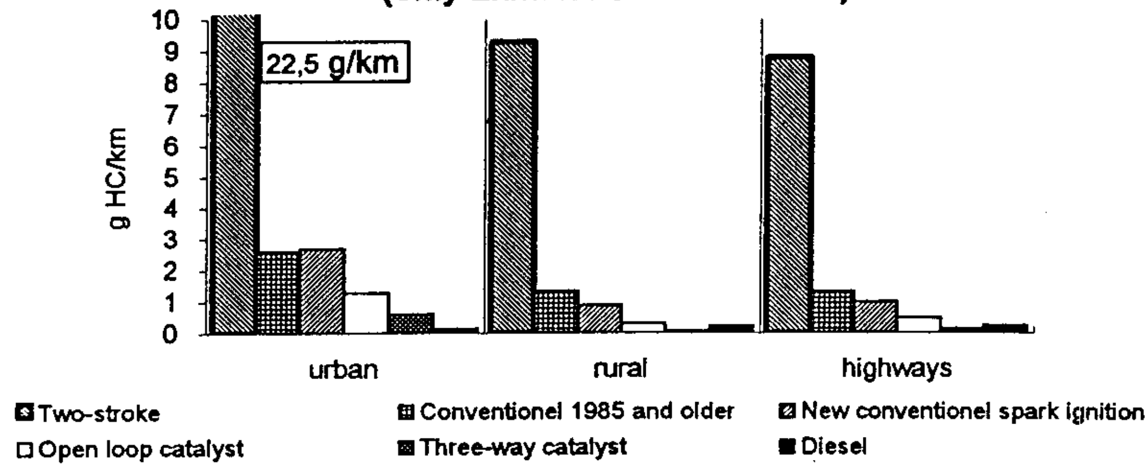


Figure 13 shows only the exhaust gas emissions and does not include the evaporative emissions. The evaporative emissions of gasoline passenger cars are reduced by 70% to

90% by introduction of charcoal canisters, which are also asked to be introduced by the mentioned EEC-regulation.

Figure 13: Hydrocarbon-Emission Factors for Passenger Cars (only Exhaust Gas Emissions)



Recent evaluations of the Federal Environmental Agency show a potential of a further 70%-80% reduction, by introducing improved technology like electrically heated converter systems, improved λ-control, start catalyst etc. This leads to similar concepts as for the Californian ultra low emission vehicles (ULEV).

For heavy duty vehicles an exhaust gas reduction is achieved by the current EEC-standards. These standards are given in table 4 with an additional proposal of the German Government. For NO_x these standards provide a 35%-reduction in the first step, 45%-reduction in the second step and 60%-reduction in the third step compared to regulation 88/77/EEC, which does not cut emissions remarkable. Further emission reductions are necessary, because of the strong traffic growth of this vehicle category. They are possible by the introduction of CNG-spark-ignition engines with three-way catalysts e.g. for urban busses or by the introduction of the SCR-technology in diesel engines. With these technologies reduction rates of 70% to 90% for NO_x are achievable.

	88/77/EEC starting 1988/90	91/542/EEC 1st step from 1992/92	2nd step from 1995/96	German proposal 3rd step from 1999
CO	12,3 g/kWh	4,9 g/kWh	4,0 g/kWh	2,0 g/kWh
HC	2,6 g/kWh	1,23 g/kWh	1,1 g/kWh	0,6 g/kWh
NO_x	15,8 g/kWh	9,0 g/kWh	7,0 g/kWh	less than 5,0 g/kWh
PM	---	0,4 g/kWh *	0,15 g/kWh	less than 0,1 g/kWh

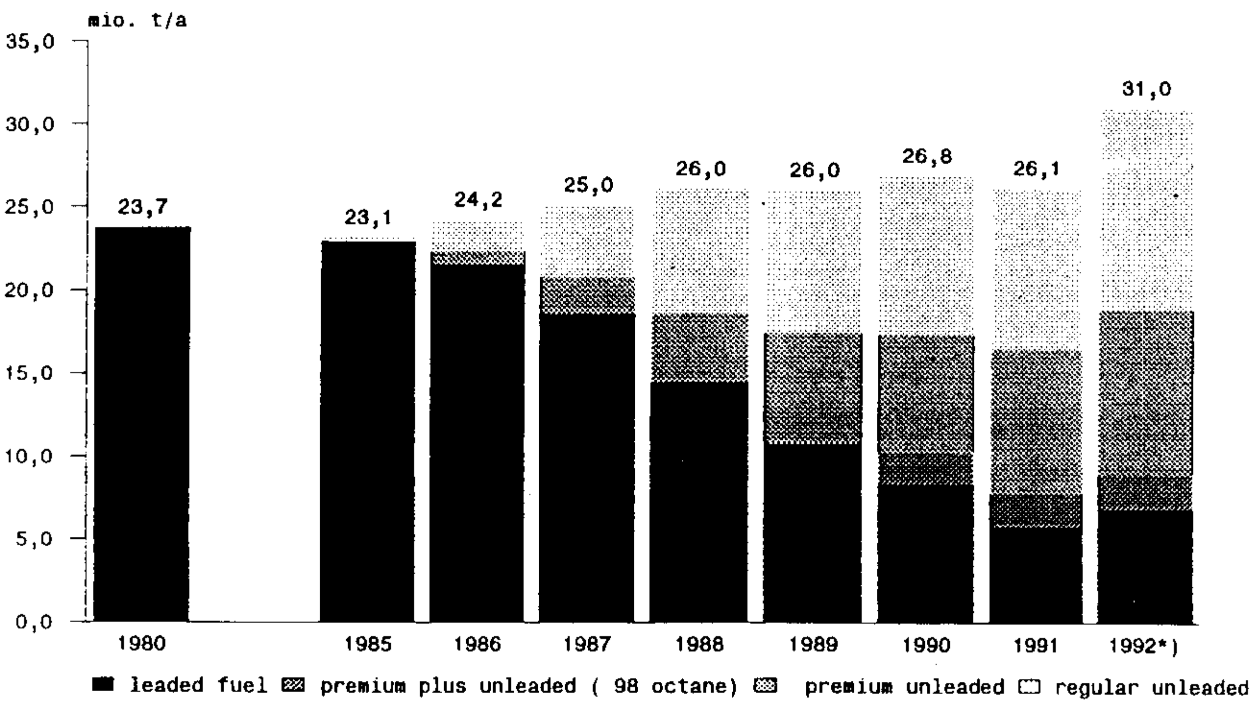
* 0,68 g/kWh for engines with less than 85 kW

table 4: Exhaust gas standards for heavy duty vehicles (conformity of production)

The draft amendment to part II of the technical annex to the protocol to the convention on long-range transboundary air pollution and their transboundary fluxes concerning the control of emissions of nitrogen oxides and annex III to the protocol concerning the control of volatile organic compounds gives advice for the relevant reduction technology for road traffic and their costs.

Also fuel quality has an important impact on air pollutant emissions from motorized vehicles. First of all the lead has to be mentioned, but in all west European countries the amount of unleaded fuel is becoming dominant. In Germany nearly no leaded gasoline is sold any more (figure 14). Secondly the content of benzene (is discussed to be lower than 1 vol.%) and aromatics in gasoline is important for the amount and structure of volatile organic compounds. The volatility of gasoline influences directly the evaporative emissions. Diesel emissions are affected through the sulphur content and the Cetan number (figure 15).

Figure 14: Fuel sales (gasoline)



*) including new "Länder"

Reference: Federal Environmental Agency

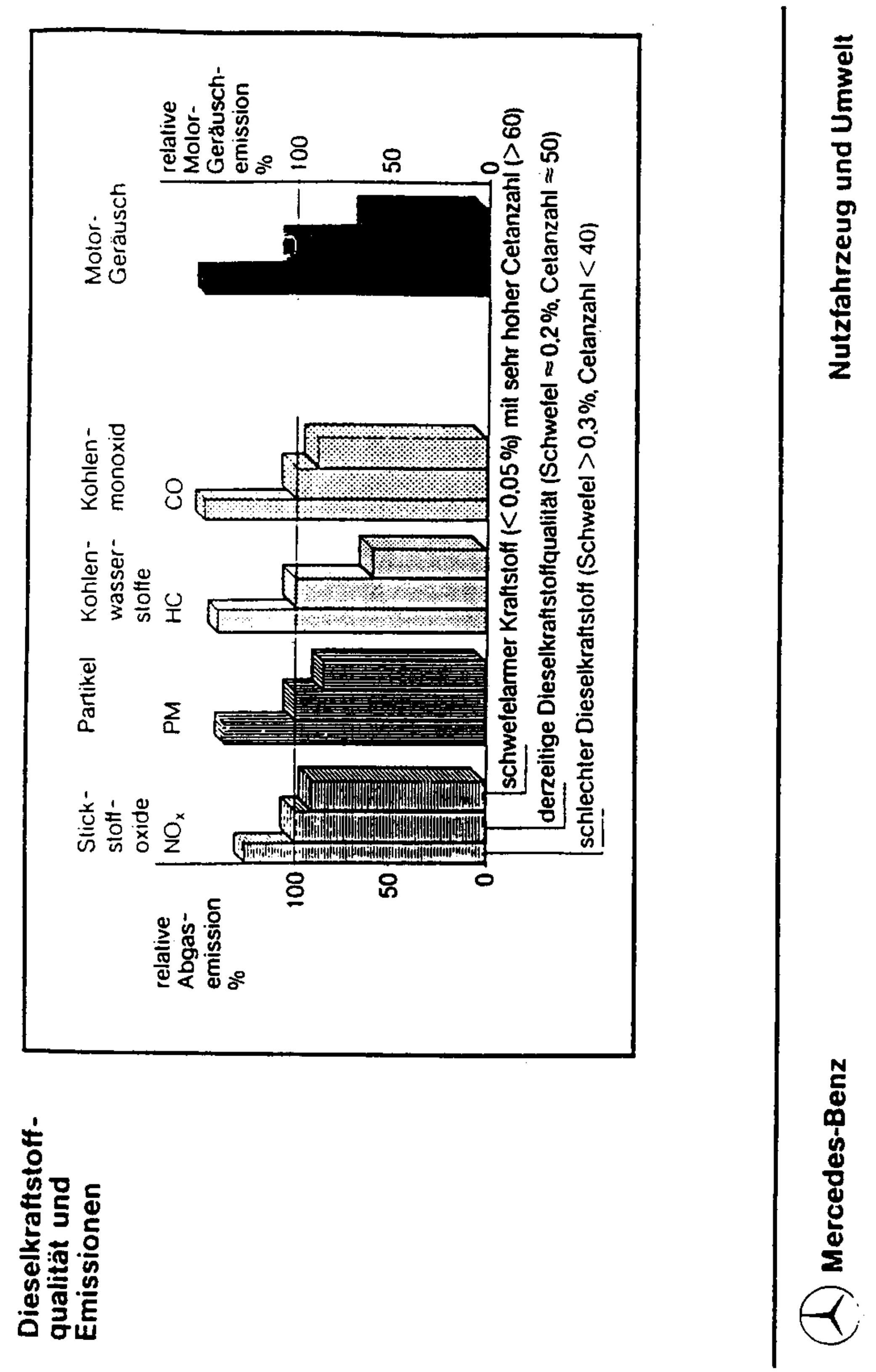


Figure 15: Diesel Fuel Quality and Emissions (first column: less than 0,05 vol.% sulphur, Cetan-No. > 60; second column: Diesel fuel quality of today, sulphur 0,2 vol%, Cetan-No. 50; third column: poor Diesel quality, sulphur > 0,3 vol.%, Cetan-No. < 40)

4.2 Fiscal Measures

Legal regulations and standards alone cannot supply a sufficient emission situation. They should be combined with fiscal measures, which take into account the "polluter pays principle" and lead to correct transport prices by internalisation of external costs. Fiscal measures can help to

- make transport more efficient and avoid transport, which is not necessary;
- shift transport to more environmentally transport modes;
- improve the technical application of vehicles, especially to reduce fuel consumption.

The external environmental costs of transport are burdened by the public. Estimations on the level of external prices vary wide. A recent study commissioned by the union international des chemins de fer (UIC) had the following results for the relative external costs in EUR 17 (European Community plus Switzerland andNorway)in the year 1991, compared with the results for Germany:

Type of Effect		Road			Rail		Aviation		Ship
		Cars	Buses	Freight	Passenger	Freight	Passenger	Freight	Freight
		ECU/ 1000 pkm	ECU/ 1000 pkm	ECU/ 1000 tkm	ECU/ 1000 pkm	ECU/ 1000 tkm	ECU/ 1000 pkm	ECU/ 1000 tkm	ECU/ 1000 tkm
Accidents	EUR 17	32,3	9,4	22,2	1,9	0,9	-	-	-
	Germany	45,5	10,8	17,8	2,1	1,0	-	-	-
Noise	EUR 17	4,5	4,2	12,7	3,1	4,7	3,0	16,5	-
	Germany	6,3	5,1	10,9	4,4	5,4	3,8	18,8	-
Air Pollution	EUR 17	6,6	4,14	13,0	2,0	0,7	5,0	26,3	4,2
	Germany	6,6	4,6	10,2	2,4	0,6	5,9	30,0	4,2
Climate	EUR 17	6,6	2,7	10,6	3,0	1,1	9,8	50,5	1,9
	Germany	7,6	2,7	7,5	4,5	1,5	10,8	55,1	2,0
Total	EUR 17	50,1	20,4	58,4	10,0	7,3	17,8	93,2	6,1
	Germany	66,1	23,3	46,3	13,5	8,5	20,4	103,9	6,2

Table 5: estimations of external effects transport in Europe and Germany

The passenger car mileage is directly linked to the fuel price, what analysis of the trend of fuel price and mileage in the past demonstrated (figure 16). After high rises in fuel prices, e.g. during the oil crisis 1973 and 1981 or after the elevation of excise duties on 01-01-1994, the mileage fell significantly. The assumption of short-distance elasticity of -0,3 for the fuel price seems to be true. The excise duty on fuel is one key measure to influence mileage and specific fuel consumption of vehicles and subsequent their emissions.

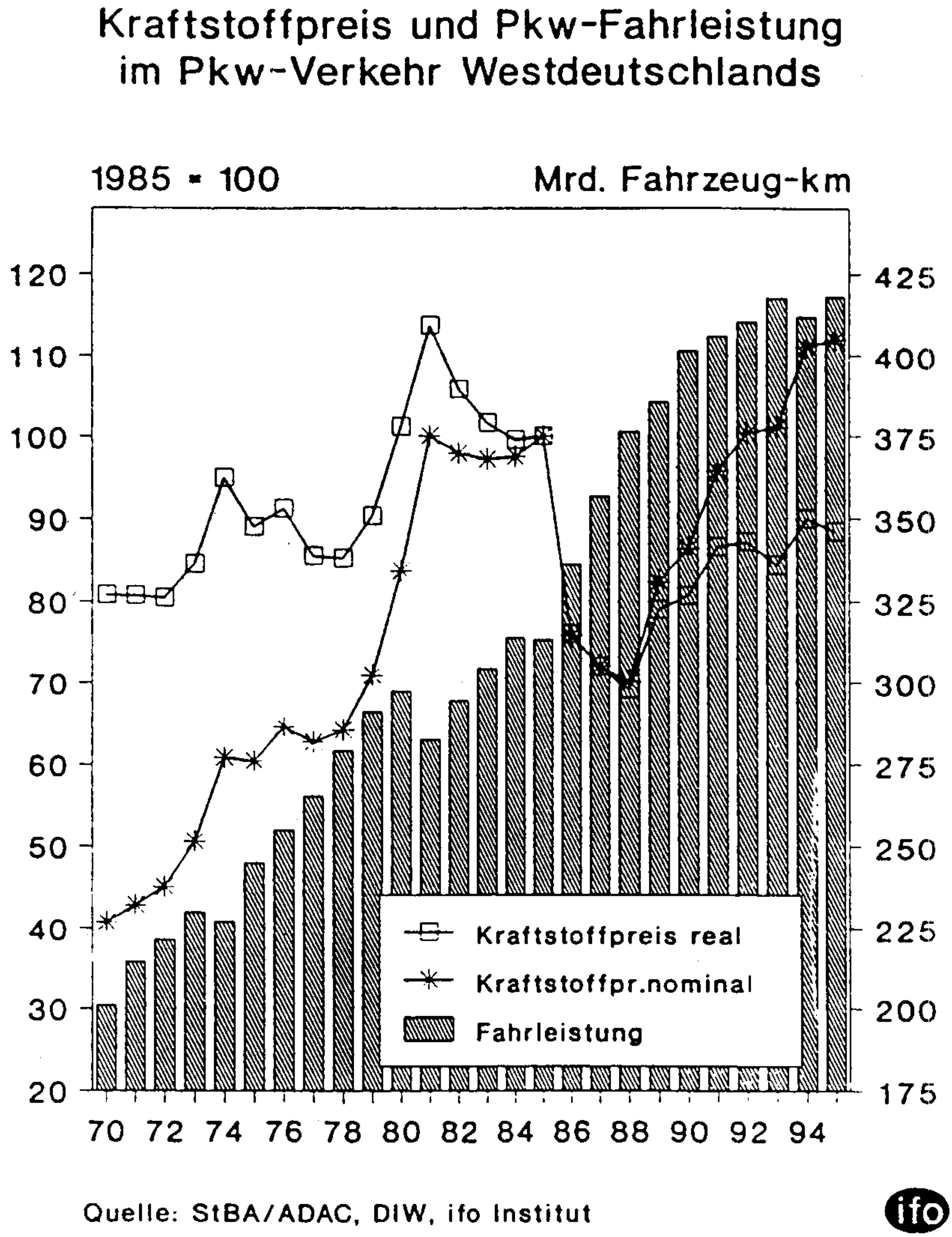


Figure 16: Fuel prices and Mileage of Passenger Car Traffic in West Germany (checked patterns: real prices of fuel, rhombic patterns: nominal fuel prices, columns: mileage)

4.3 Measures to Shift Transport Modes

Szenario calculations and analysis of realisation chances showed, that these technical measures will not be enable sufficiently to solve the air pollutant problems of traffic. So it is likely to discuss and implement additional measures, which lead to transport avoidance and/or shifts to more environmentally friendly transport modes. A recent published study of the Federal Environmental Agency demonstrated the possible shifts in freight transport from road to rail and inland waterways. The comparison of the specific emissions clarified the environmental advantages of rail freight transport and inland waterways per tonnekilometer for all pollutants (see figure 17).

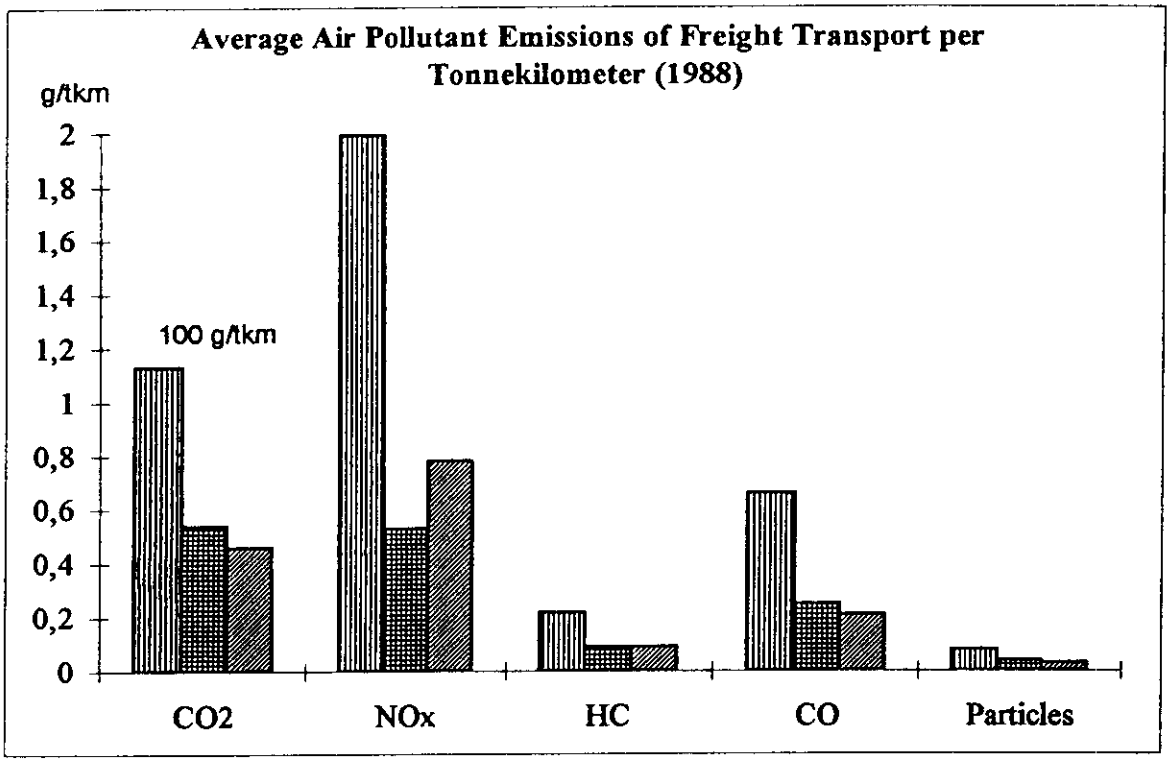


figure 17:

4.4 Organisation, Planning and Design of Transport and Infrastructure

Germany has intensive experiences in the realisation of *traffic calming*. Traffic calming means to bring back the urban road to the citizens, by reducing the speed of the vehicles, by reconstruction and greening the streets, by strengthening public transport, bicycle- and feet-traffic, by improving living conditions, by making city areas living and vital again. This has as well positive effects on noise reduction and air quality and reduces accidents. Last but not least people need not to escape from the city so often; they spend more time in their living area and use environmentally friendly modes, which reduces motorized traffic significantly. Traffic calming can only be successful, if the citizens take part in the planning process and when the "push and pull" principle is applied. "push and pull" means to pull environmentally friendly transport modes and push individual motorized traffic out of the streets. A good example are bus lanes, which take away a part of the street area from cars and give it to public transport.

The construction of new transport infrastructure implies the danger of newly generated traffic, due to the improvement of accessibility. Therefor contradictionary affects have to be taken in account.

The important role of spatial planning and land use for the generation of traffic was mentioned already. Although an intelligent, traffic avoiding spatial planning needs a long time, it is very important to start a revised process today, to overcome the existent structures and to head to a sustainable mobility.

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DR. RUDOLF PETERSEN

STRATEGY FOR AN ENVIRONMENTALLY SUSTAINABLE TRANSPORT DEVELOPMENT

1. Transport and the Environment in the Baltic Sea Area - What are the Problems?

The contribution of the transportation sector to environmental and health damages becomes more and more important. Pollutant emissions, traffic noise, destruction of local ecosystems due to highway construction, spoiling of ground water as well as of rivers and seas, and climate change in micro and macro scale are inevitably linked with the transportation sector, especially with passenger car traffic in wealthy countries. From maritime and coastal pollution by tankers direct lines can be drawn to motor vehicle transport due to its high share of the overall crude oil demand.

Air Pollution

In Europe, transportation is responsible for an important part of air pollution by Nitrogene Oxides, Carbon Monoxide, organic compounds and carcinogenic particulates. Mobile sources account for up to 80% of these emissions causing damages to man's health and to nature. Most transport related environmental problems in highly industrialized countries are caused by automobile use and road haulage. This is despite the fact that the specific emissions (in terms of g pollutant per km of each vehicle) are probably significantly lower than those of the vehicle fleets in the former COMECON countries.

Increasing vehicle fleets and mileage have upset the effects of improvements in vehicle technology in many countries. Los Angeles is facing another 20 years exceeding National Ambient Air Quality Standards (NAAQS); many cities in the EEC suffer from serious air quality problems, especially Ozone, Nitrogene Dioxide and various hazardous Hydrocarbons. Developing countries are constantly confronted with increasing transport emissions and associated toxic emission concentrations in capitals like Mexico City, Bangkok, Santiago, although having emission regulations implemented.

Within the EEC, the expected growth in motorized passenger and goods transport will cause further increasing emissions of NOx and CO2 (the latter due to increased energy consumption). Technical progress enforced by EEC Directives seems to be far to slow under the conditions of an overwhelming motorization process. Land use demand for roads, airports and infrastructure and high death tolls caused by traffic accidents remain unsolved problems.

Traffic Congestion and Economic Losses

In addition to the ecological effects, there are a lot of traffic problems concerning private and commercial road users. Transport demand is increasing faster than the construction of new roads resulting in growing traffic congestions spoiling cost and nerves. Experiences in USA, Japan and several European countries have shown that even with immense budget spending on highway programs congestion has grown and will probably grow further. Automobile oriented transport policy obviously has come to a dead end.

With ecological as well as congestion problems still growing, economic advantage of Western level of motorized transport is to be questioned. The social costs and benefits of transportation have been estimated in several studies resulting in huge deficits. Externalized social costs do exceed current taxes and other payments of vehicle owners and users several times.

2. Economic Growth,Transport Demand and the Need for Sustainability

Passenger Transport

The striking correlation between the increase in automobile use and the development of GDP in highly industrialized countries during the last decades is sometimes interpreted in that way, that it was the automobile that speeded up progress of the national economies. But things are in fact a little more complicated. For countries with a strong domestic automobile industry, success of the manufacturers has indeed been one of the driving forces. Car production of course contributes to national wealth.

Often the increase of car fleets means growing expenses of consumers for an imported product. Individual car ownership and car usage is very closely correlated to rising incomes. If people can afford to own and to drive an automobile they usually do so - independent of any rational or logic arguments. During its first decades the automobile has been a toy for a few rich people; afterwards it has become a vehicle for always greater parts of the public. Now it is used for everyday business, for trips to and from work, for delivering or consuming services and for basic shopping, but this is less than half of the story.

In wealthy and highly motorized countries, more than 50 % of the automobile kilometres are spent on trips for leisure and holidays. Additionally, shopping becomes merely a leisure activity. National economies do not specifically profit by these trips. On the contrary, import of automobiles and fuels as well as construction of road infrastructure may create budget deficits and foreign debts. Especially in developing countries fuel bills cause an imbalance of payment.

Car ownership creates new mobility patterns. Substituting other transport modes makes a minor part of additional car kilometres; the decrease in use of public transportation is far below the increase in passenger car use. The spatial orientation of automobile users immediately changes with respect to leisure and holidays. Correlated to infrastructural development it changes with respect to shopping and services, and in the long run the settlements change towards automobile oriented structures. The consequences of these changes are longer distances in general, and an overall increase in car trips. More and more cars are bought, partly due to unfavourable spatial structures and partly due to individual preferences. Congestion, pollutant and noise emissions as well as danger of accidents let people move to the outskirts of the cities thus creating even more traffic related problems.

Spatial structures secifically basing on automobile use cannot be served efficiently by public transportation. Life styles which mainly have been developed by using automobiles can hardly be pursued with other transport modes. Society as a whole is trapped by the automobile. Politicians and planners - helpless to find solutions - continue this path even if it is clear that problems won't be solved that way. Experiences in all highly motorized countries show that life styles and spatial structures oriented towards passenger cars inevitably lead to ecological problems and traffic constraints no matter what kind of advanced emission regulations and elaborate road construction programs have been implemented.

Goods Transport

Is economic growth and welfare closely linked with more transport, especially more motorized road transport with severe environmental consequences? Economists and transportation-scientists argue that economic development in space is narrowly linked with the development of transportation-infrastructures, and distributing wealth effects belongs to a well organised transportation-economy (competition, modal-choices, deregulation, no limits). Their opinion is, that a dysfunctional transport infrastructure necessarily prevents the region from earning economic benefits. This question needs differentiated answers, because the framework of economic and transport growth in the highly industrialised countries is quiet different from the situation in the former COMECON-Member States. When new free-market zones in Europe and North-America are prepared or being realised to support free trade and liberalised relationships worldwide (European Common Market; NAFTA), it seems as if basic infrastructures and technologies in transport and communication have the key function in the economic system. But costs and benefits are uneven developed.

On the macroeconomic, interregional level we have to point out the direction in which regional development shall go: is it primary the political aim to close the connections between the Baltic States and the European Internal Market, or is there a realistic perspective, perhaps particularly, for regional differentiation and orientation around a spatial "center" like the Baltic Sea, with specific transport consequences. From the environmental point of view, the transport-effects of a big internal market in West-, Middle- and Eastern Europe could be a severe problem, according to the experiences in the EC; and there are some other questions from the economic point of view too: whose goods will be transported for whose benefits? Ant the experiences in industrial development of peripheric european regions and the role of the transport sector show, that economic effects can be distributed in both directions, most of the advantges are regularly developing from the periphery to the center, not vice versa. Today it is unsure to stimulate regional and interregional growth first of all by building transport infrastructures.

On the local, company level there is another question with importance for the microeconomic decision making: In fact, the transportation infrastructure is still one of the important factors valueing the quality of business locations. But this does not determine the way how to realise the best accomodations for companies. There are also other relevant location-factors, like adequad sitings for firms in developed areas, functioning energy supply and waste/water management, and indeed qualified workers, the right business environment of service industries and subcontractors, and: An intact natural environment and lively conditions in a social and cultural matter is also important. Their attractive combination - and not the break through in one field of the infrastructure - will get the business people making their decisions prefered to the benefit of the region.

Recent regional theory and policy are discussing the region as a third level for acting between macroeconomics (world-market, national and interregional economy) and microeconomics (business sphere). The regional level is discussed as important for economic chances, because the success of companies and communities depends on the helpful interaction of local and regional, public and private, industrial and service actors. According to this strategy, the competition research gives some interesting comments to the importance of this intermediary level: Any successful world-market-strategy, so Porter argues in his "Competitive Advantage of Nations" (Porter 1990), is "home-based". What is the impact of this theory for transportation and infrastructure planning? Our thesis is, that - from the business perspective - it will be as necessary to look for local and regional networks and interlinkages as it is to make the region accessable for foreign transport flows.

3. The Importance of Urban and Spatial Planning

One of the most important factors influencing trip generation and transport mode choice is the urban and rural structure. There is a fundamental difference between the genesis of the land-use-patterns in Europe and Japan on the one hand and in North-America and Australia on the other hand. Traditional European cities give good examples for dense and compact structures (at least up to the 70s) with less transport dependence. Cities between 50.000 and 500.000 have found to be least dependant on automobile use. They keep all important centres of economic, social and cultural activities without losing natural sites which can easilily be reached for leisure and recreation puposes.places.

Avoiding Traffic Generating Land Use Patterns

Australian and North-American cities consists of huge, wide areas with extremly low density which can only be served sufficiently by the automobile. In the Northeastern Illinois Metropolitan Area as a typical area of the U.S. for instance, the region's overall population increased between 1980 and 1990 by only 4,1 percent, while the residential land consumption increased at the same time by estimated 46 percent. Newman and Kenworthy showed the connection between low density of urban structure and energy consumption by transportation in several areas of the US, Europe, Asia and Australia in their international sourcebook. But official transport and environmental policy in the USA never questions the automobile oriented development path even its limitations are obvious.

European town planners today are learning from the overseas´ experiences, although in wealthy and highly motorized European countries similar processes are currently going on. In Germany the results of the last public census showed a massive decentralization between 1970 and 1987, in other European countries similar changes can be observed. Housing, employment and entertainment-industry changed from the town to the suburbs and generated land-use, transportation and waste problems. Since suburbanization is linked with private motorization, it sets up also new demands for automobile use. The automobile-dependency of urban and suburban structures leads to a specific kind of transport and energy intensity of the land-use.

Preserving Structures Favourable for Non-Motorized Transport in Cities

Now there is the question if spatial planning concepts can be implemented to revise unfavourable structures that already had manifested in highly motorized countries and to prevent false development in those countries still facing the process of full motorisation. In the former state economy countries, compact settlement patterns have partly be preserved, and new settlement areas often keep some potentials to avoid excessive automobile use for everyday trips. With traditional town shapes not being destroyed by construction of huge city highways, offering good mobility chances by public transport, creating attractive networks for pedestrians and cyclists, it should be able to limit demand for passenger car use. Restrictive policy elements like parking and road pricing, automobile-free city centres and living areas would also be important.

Due to the relative low housing space per capita, in the former state economy countries massive investments in new settlements will be made in the next decades. This gives some chances for new agglomerations to be planned from the beginning towards low automobile dependency with sufficient density for good public transport and non-motorized mobility, and different functions saving transport demand. If good living conditions can be realized within medium sized cities this may be attractive for future development avoiding extensive land-use-patterns like those in the USA and Australia.

The way people are housing and companies are siting (and how all the subsystems are connected and thus is changing over the years) makes decisions that have a great long-term influence on the transportation system. Living in single-family-houses in a pretty nice rural, green surrounding is a lifestyle that includes the use of a passenger car (and a second and a third with growing income, emancipation of women and "consumers kids"). If this development is to be avoided for economic and environmental reasons, alternative town and spatial planning has to be implemented. A problem still unsolved in a free market economy is the economic competition between the cities and their neighbourhood towns which forces all of them not to resist land-wasting wishes of developers, enterprises and individual settlers.

4. Infrastructure Investments for Sustainable Mobility

More Roads for Economic growth?

Cheap transportation in terms of low energy prices and perfect highway networks support the process of ever increasing transport activity leading to increasing externalization of social costs. Classical economists speak in favour of this development path: "The cheap, fast, safe and regular transport of people and goods is one of the most powerful driving forces behind national prosperity and civilization." (F. List 1840 looking at the railways). It seems to be a very convincing: The better and the cheaper the transport facilities are, the larger the markets are. The larger the markets are, the more pronounced the distribution of work is, specialization, economies of scale, and according prosperity at last.

But there are more and more restrictions for a policy which is mostly based on building additional road infrastructures and increasing energy consumption. What are the policy alternatives to enable economic prosperity and social welfare without accepting more and more negative effects? Influencing transport mode choice, especially changing from raod to rail and shipment is one answer but is a limited strategy because of capacity restraints and the very special attributes of the transport modes. In the long run, organisation concepts for reduced transport demand in a modern economy have to be developed.

Public Infrastructure for Low Transport Demand

If we look at the fundamental needs of the commercial and private road users its not transport what they want but other purposes: Making competitive products and sell them to the consumer is the aim of the industry. For the individual work, leisure, shopping and all other elements of life are the aims that may either be followed on the traditional development path (with increasing traffic) or by reducing the distances between the places where the activities can take place. The principle of sustainable mobility is to focus at the purposes of transport and not on transport itself. Political action should concentrate on influencing the demand for transport instead of supplying additional transportation capacity.

Reduction of transport demand in the commercial sector has to start by questioning the relations between third world resp. developing countries delivering raw materials, is has to discuss the international material flow towards the high consuming countries, and waste disposal in the rich regions of the world. Beyond the fact that the current situation lets the poor countries become more and more dependant on exploiting their resources without reaching economic stability, shipment of cheap raw materials hinders the rich countries from building up regional economic recycling circles. Efficient use of energy and raw materials within a regional scale is enforced by high energy and material costs and high costs of transport.

Meeting the Demands of Enterprises without Additional Roads

Construction of additional transport infrastructure following the demands articulated by industry and lobbying organisations leads in the wrong direction. In order to support regional orientation of the industry, information networks and exchange of know-how should be organised by public authorities. Intensified communication should take place to integrate the needs of all parties. Qualification of local work-men and as well as intensifying cooperation between universities and industry will give more support for the competitiveness of local businesses than spending tax revenues on road construction withour a chance to ever solve the real problems. It should be made clear towards the commercial sector that public support is given for all steps directing to less transportation and to environment protecting measures.

With respect to private traffic participants, demand side management aims at the reduction of transport needs by integrating different functions of life. Spatial structures which had been spread under the influence of increased automobile use have to be revised step-by-step. Mobility as a key word in modern society is to be interpreted by the amount of activity option one has and not by the distances driven. (See also below)

The Role of Correct Costs to Implement Transport Saving Structures

New transport saving structures in production and distribution chains have to be developed by the manufacturers under the gudance of correct market prices. The role of the governments is to establish a suitable framework, especially by fiscal measures. Shifting the fiscal burdens for enterprises from taxation of favourable production factors (labor), of turnover and of profit to the consumption of non-renewable resources and emissions may convince the manufacturers to look for according orientation.

5. Public Transport and Local Transport Planning

Transport Planning for the Post-Automobile Age?

The cities and conurbations feel the problems raised by increased road transport most urgently, and often they have developed solutions that are far more advanced than the policy framework on national or even EEC level. While the latter continues its orientation towards increasing transport demand as a prerequisite for economic growth, many cities are realizing that the decades of planning mainly for the automobile have come to an end.

Urban transport planning concentrates on restrictions against private automobile use on the one hand and support for environmentally favourable transport modes on the other hand. Both has to fit together to reach a turnaround in traffic development.

Fiscal and Regulative Support Needed

The *nuclei* of advanced future transport development on local level have to be supported by according fiscal strategies to be implemented on national and EEC level (see below) but demand also changes in traffic regulations. National laws set the technical standards for motor vehicles as well as the speed limits, planning guidelines, and most often they contribute to the financing of local investments. These guidelines have to be changed if sustainable transport development on local and regional level should come true.

6. Fiscal Strategy for Sustainable Transport Development

Current Reasons for Transport Increase

If the cost of goods transport is below that of other alternatives within the production and distribution chain, profit is raised by increasing tranport acivities. Accordingly, passenger car use is preferred if the respective activity is more attractive than alternative choices. The decision if certain goods are transported and what transport mode is chosen is due to economic parameters. Transport cost are not only influenced by the price of the fuel, taxes and road tolls but also by labor cost. Because of the drivers' wages and the capital cost of the freight, the average speed a truck can make on its way often plays an important role in the cost calculation.

With respect to passenger car use, additional factors like image, the joy of driving etc. may be added but cost and time will be important, too. Increasing the price of freight transport and of passenger car use (and reducing average trip speed) therefore is a suitable approach to encourage individual and commercial traffic participants to minimize their traffic demand.

Long Term Fiscal Strategy Necessary

From one day to another and within existing structures, car drivers have only limited ways to react to a higher price at the gas station. Introducing very high fuel taxes immediately to raise transport cost in order to influence traffic demand then only means higher costs for motorists without enabling them to develop alternatives. This always raises the question whether additional financial burdens on motorists are justified. Often then it is argued that vehicle and fuel taxes exceed public expenses on road construction and maintenance, maybe even the cost for traffic police and other services.

This view is far to narrow. A proper calculation of the costs caused by motorized traffic has to include not only the direct expenditures but the indirect damages to people and the environment. These include harmful effects of air pollution and noise upon human health, forest damages and water pollution, repairs on buildings due to corrosion caused by acid rain, reduced crop productivity, and many other items. Often the social costs caused by traffic accidents are not covered completely by the insurance rates payed by drivers but are charged to public health care or other public budgets.

What are Correct Prices for Transport?

Costs not payed by the car user are *external costs* and may exceed the tax revenues by several times. Serious estimates have been made on social and ecological costs of motorized traffic in Germany resulting in more than US-$ 2.000 per capita a year. Fiscal measures to cover these costs would result in fuel taxes of some US-$ 2 to 3 per litre gasoline or Diesel or (for road freight transport) charges of some US-$ 0,15 per ton-km.

For systematic reasons, these estimates do not include the possible consequences of global warming because of the uncertainty of its effects. A lot of harmful effects which are unknown to us today cannot be taken into consideration which leads to the consequence that the calculated payments necessary to *internalize* ecological and social costs represent minimum taxes resp. charges.

Further research should be made to evaluate full external costs, but actually it seems to be more important to take concrete steps to allocate the costs to the agent producing the damage. In order to avoid economic and social turbulences and to develop alternatives to the existing fleets of *gas guzzlers* step-by-step increases of taxation by 5 to 10 % annually (in constant dollars) should be implemented.

Without internalizing external costs, incorrect allocation of resources takes place. Participants of the transport market take natural resources for free and waste them. National economies will sooner or later suffer from the damages imposed on society and the ecosystem. Only if they pay for what it is worth, product innovation comes to the market which enables the establishment of really efficient transport systems.

7. Enforcing Prohress in Vehicle and Fuel Technology

Need for Standards and Regulations

Even with fiscal policies forming the basic framework for sustainable development, additional environment and traffic planning activities are necessary to gather full effect. Price policy needs some time to let the consumer respond in the desired manner. But in many regions urgent health and environmental problems deserve immediate govermental steps. Concerning the automobile itself and its emissions and safety features, a regulative system ought to be implemented consisting of standards and procedures for certification of new models and field surveys for in-use vehicles to ensure proper function of the emission control devices. Additional fiscal measures may support introduction of further tightened standards.

Effective I/M Programs Necessary

Compliance of in-use vehicles with emission regulations should be controlled both by centralized programs covering the most popular models and by decentralized inspection and maintenance programs covering all vehicles. The latter program is adressed to the customers and forces them to keep the cars in good shape. The manufacturers resp. importers should be responsible that all vehicles meet the emission standards during its useful lifetime if the user acts according to the manufacturers direction for use and maintenance.

Advanced Fuel efficiency, Emission and Noise Regulations

All states of the Baltic Sea area should introduce state-of-the-art emission and noise vehicle standards comparable to current EEC regulations or those adopted by the Stockholm Group. For gasoline powered passenger cars and Light Duty Vehicles this would demand the use of catalysts and unleaded fuel. A minimum octane number of 90 RON is recommended. According fuel standards should be adopted; for some elder models which need lead additivation it seems appropriate to have leaded fuel with lead contents below 0.1 g per litre available. Different tax rates should be introduced to keep the market price of unleaded gasoline below that of leaded fuel. Otherwise serious deterioration of catalyst function is likely to occur resulting in higher exhaust emissions.

Air quality resp. noise standards should be introduced within a regulatory framework for infrastructure planning. Road and rail construction projects should be discussed and decided with broad public participation to ensure support by citizens. Quality standards for public transportation as well as favourable conditions for pedestrians and cyclists contribute to the development of sustainable mobility in cities and conurbations. Centralized planning often tends to focus on high speed and long distance projects neglecting the actual demands of the people. Guidelines for spatial and infrastructure planning and legal procedures should be implemented to balance the benefits of nature, environment and public health on the one hand, and of industry interests and regional economic development on the other hand.

Alternative Technologies in Transport

Of the various alternative technologies discussed in this report none proposes to solve the problems associated with current motorized transport within a timeframe of one or two decades. This is especially the fact for alternative fuels and electrical powered vehicles - with the exception of CNG that may be very useful for urban buses and LPG for urban delivery trucks. Cost-effectiveness of programs for catalyst retrofitting should be evaluated very carefully and weighted against support of public transport and restrictions for passenger car use.

The general experience should be taken seriously that additional transport supply has always led to additional demands. This is true not only for road extensions but also for high-speed trains like TGV and ICE in France resp. Germany.

Sometimes the development of modern telecommunication networks is expected to reduce the demand for physical transport. Telework, teleshopping and on-line conferences indeed offer potential advantages as far as transport of information used to replace transport of persons. General experience has proven that other effects take place: informational links have generated additional demand for physical transport. New markets can be developed, cooperation over great distances becomes possible due to fast communication with fax machines and computer networks which creates the need for additional travels. The hope that modern communication systems would help to reduce travel demand has turned out to be as false as the hope that the use of computers would lead to a *paperless office*.

8. Recommendations

In order to achieve sustainable development in the transportation sector, environmental and transportation policy has three major fields of action for the future, which differ according to the time schedule:

First, standards for energy consumption. exhaust emissions and noise must be introduced resp. tightened to a level that allows achievement of all necessary environmental goals.

Second, an integrated transport policy approach would have to optimize the shares of the different transportation modes according to the specific advantages of each mode. This approach would lead e.g. to a reduction of passenger car transport by means of more and better mass transportation systems, and the shift of long distance road transport to rail. This would be supported by fiscal measures to inlude external costs into the individual and commercial cost calculations.

Structural changes in the spatial distributions of origins and destinations of transport that occured during the last low-transport-cost decades in urban development and in the industry have to be revised in terms of less transport needs. There is evidence that the way the industrialized countries are organizing their social and economic life can not serve as a model for the whole world. Spending so much energy, i.e. natural resources on transportation (as well as on other energy usages) creates a deep injustice for the less industrialized part of the world that ought not to last forever.

These strategies are widely discussed and accepted in general but there are only a few real answers to how to manage them in detail. Despite of the huge problems the industry is facing with the development of technical solutions regarding vehicles the first point seems to be the easiest - compared to point two and three.

Future Transportation Policy in the former COMECON-Countries

Opposite to the situation in Western and Northern Europe the transportation systems of countries like Poland, Russia or the Baltic Sea are still more determined by public transit, railway and shipping. Although it is quite difficult to make some assumptions on the future economic development, it is obvious to say that the structural change keeps critical potential for mobility problems. Especially the increasing private motorization will change the environmental situation dramatically. Today the market share of public transit is three times above the North-Western-Europe level. The economic relationship to neighbourhood countries in the EC creates wider market spheres in general, which is linked with growing demand for goods and passenger transport.

On the other hand the current status in Eastern Europe keeps opportunities in town planning und regional development, which may enable alternative ways of traffic development. Policy should aim at supporting compact urban structures and a direct supply of public infrastructure in the rural areas which are less transport and energy intensive than those in the suburban regions of Europe. Another open question is, whether there are some opportunities for industrial organisation on a lower transport level. Some aspects were discussed above.

Despite the economic and social situation and, therefore, transport structures in Sweden, Denmark and Germany are quite different from those in Poland, Russia and the Baltic States, official strategies concerning the transport sector look quite similar: Construction of new lanes or even new highways, closing gaps within the road network, bypass or widening of bottlenecks. Neither of these strategies is new, and even the fact that countries which went this way for decades face severe environmental and congestion problems is not interpreted to develop alternative policies or a threshhold, at least. Large road infrastructure extensions are planned and would be under construction now if there were no budget restrictions. This would make it impossible to escape from the vicious circle of more motorized transport, more roads and more problems.

Better strategies should be taken into account to support economic and social development in the former COMECON countries without the negative prospects.

An interesting aspect might be a spatial orientation of the Baltic Sea countries towards each other in general. Even if is acknowledged necessary at least from a political point of view to tighten the connections between the Baltic States and the European Internal Market, there might exist some realistic prospects for regional differentiation and orientation around a spatial "center" formed by the Baltic Sea.

From the traffic and environmental point of view, the consequences of a sole orientation towards the EEC countries would cause severe problems due to the overwhelming demand for long distance land transport. The thin, vulnerable links formed by highways to be built will soon suffer from congestion caused by local traffic. There are some other question marks from the economic point of view, too. Experiences with transportation planning and industrial development in peripheric regions of Western Europe show, that it is always the centre taking more advantages by using the periphery as an enlargeed working bench and conquering the market for the products.

The Baltic Sea offers unique opportunities for environmentally friendly and cheap transport. It might, therefore, be a good choice to focus future cooperation and development on close links between the states surrounding the Baltic sea and to depend on Mid-European markets to a less extent.

Need for the Western Countries: Changing to a Better Transport System

The automobile oriented transport system in highly industrialized countries has proved to be a dead end road for global and local environmental reasons. During the next decades concepts for *sustainable mobility* ought to be developed in order to reduce the burdens on the ecosystems and to enable developing countries to reach mobility affordable for their economies and the environment.

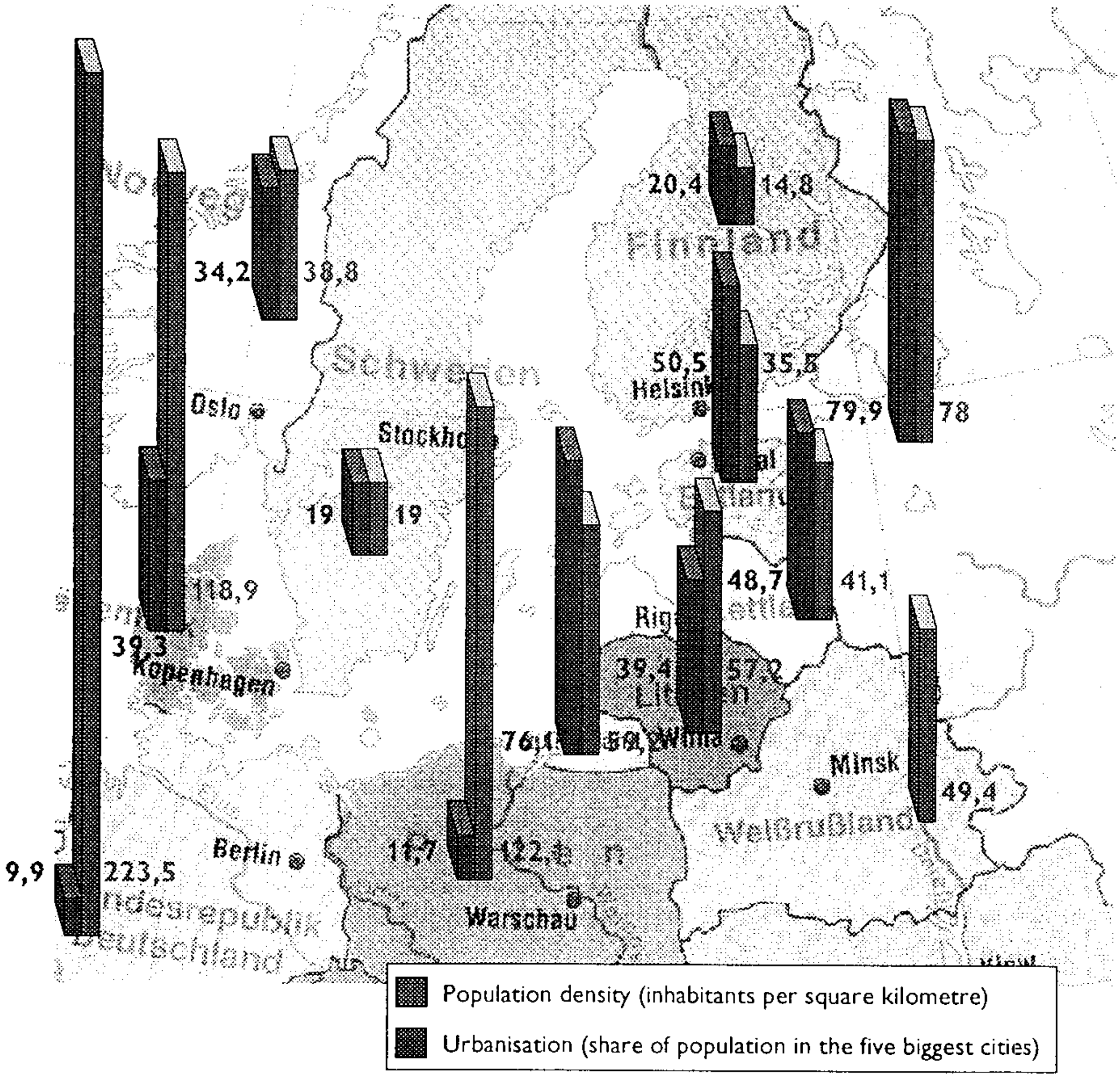
The task of the rich countries with high motorization rates is both to solve their own traffic problems and to develop models for environmentally favourable transport. Witout a changed orientation developing countries inevitably will follow the "first worlds'" road to congestion, emissions, environmental degradation, waste of non-renewable fuels and economic dependancy on oil.

The reduction of transport demand both in the passenger and goods transport sector is the most important approach to be followed up. Changing the spatial structures towards a less distance intensive life by renewing the mixture of functions that made urban life gain its qualities in the past without loss of wealth aspects is a main item. Deurbanisation created automobile use, and vice versa. Leisure patterns may be changed by building green, healthy living areas. Automobile dependancy must be reduced by developing alternative transport systems on the one hand, and step-by-step restrictions for the individual passenger car on the other hand. Internalization of external costs will support this process and will help ecological sustainable solutions penetrate the market.

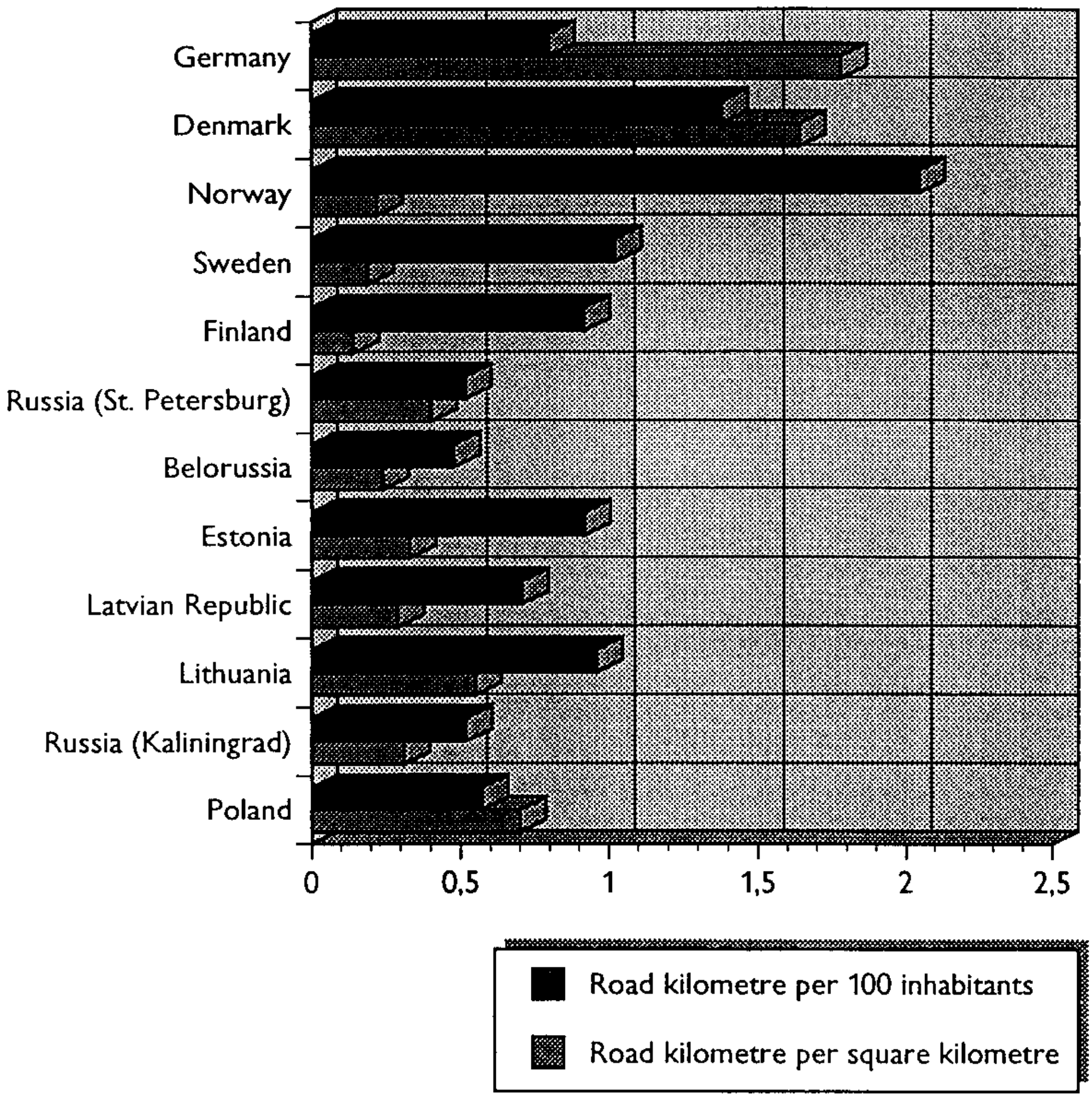
With respect to the demand for more and more road freight transport in production and distribution chains an even deeper change is urgently needed to reach the sustainable path of development. First, the fiscal framework should be revised which forces businesses to gain profits by carrying goods over increasing distances. Re-establishing regional economic circles must be the task in those fields of production and consumption where international specialization is not the decisive factor. Most of the transport demand does not arise because of spatial differentiation of resources and know-how but roots in political decision which force businesses to react. Specialization is in fact the reason for wealth, but this does not necessarily ask for great distances. With suitable fiscal measures to introduce correct ecological prices for transport it would be economically advantagous to save transport. This will probably end up to be profitable in the same way as energy saving in the industry sector in many countries since the seventies has forced new technologies to come to the market. In the long run, transport saving will generate new solutions with good economic prospects.

This text is based on a study which the author made in cooperation with Markus Hesse from the Institut für Ökologische Wirtschaftsforschung / Ecological Economics Research Institute, Wuppertal. I would like to thank M. Hesse for this cooperation.

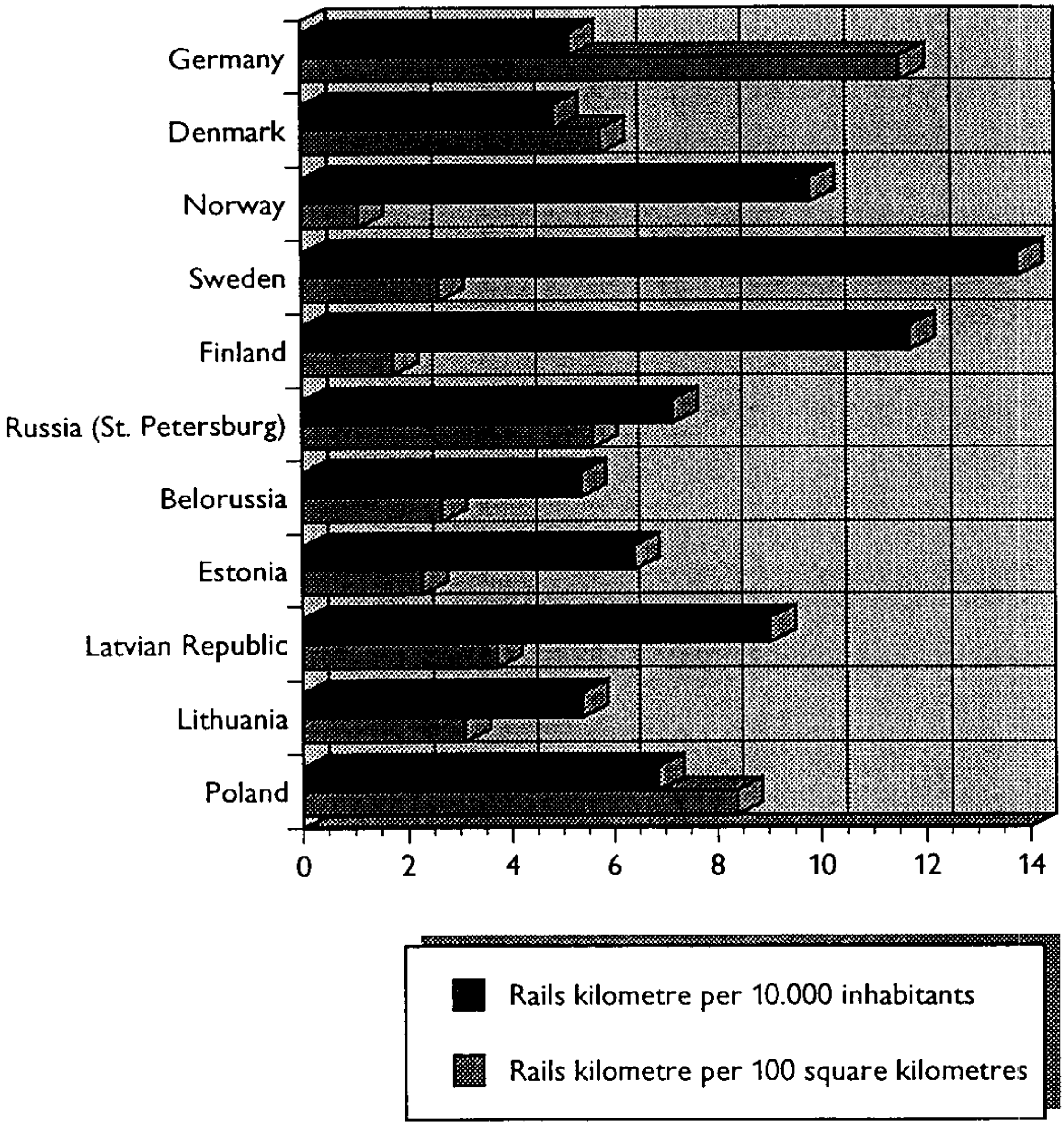
Population density and urbanisation in the Baltic Sea Area



Road Infrastructure in the Baltic Sea Area

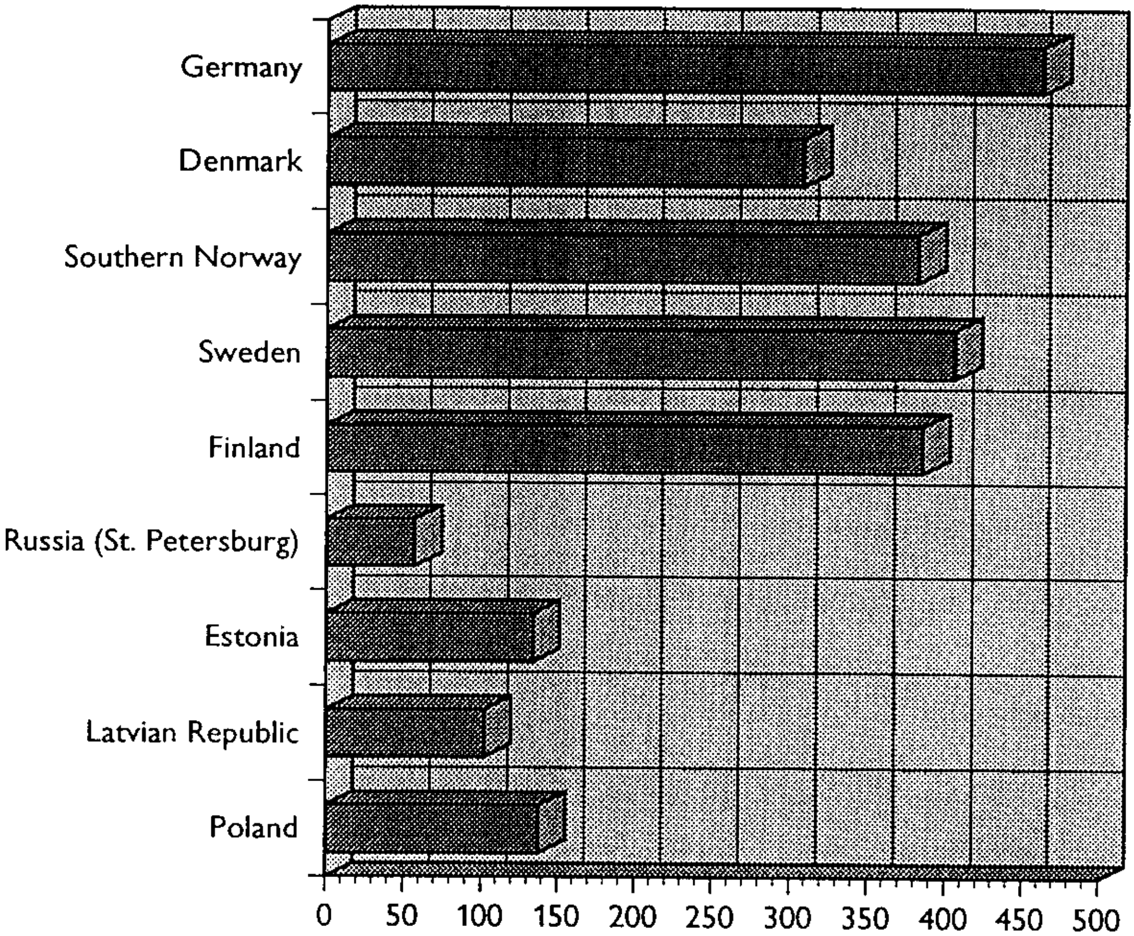


Railway networks in the Baltic Sea Area



Passenger cars in the Baltic Sea Area

Passenger cars / 1000 inhabitants



Source: various sources Wuppertal Institut VE/ap – 3

Workshop on the Reduction of Emissions from Traffic in the Baltic Sea Area

Rostock-Warnemunde (Germany)
23-27 January, 1995

LATVIA: PRESENT SITUATION ACCORDING TO TRAFFIC EMISSIONS, FUTURE DEVELOPMENT AND MEASURES

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LATVIA PRESENT SITUATION ACCORDING TO TRAFFIC MISSIONS, FUTURE DEVELOPMENT AND MEASURES

INTRODUCTION

Latvia is a country at the Baltic Sea with total territory of 64 600 square km and 2.56 million inhabitants.

Since the declaration of independence has been accepted in May of 1990, great changes have happened. Politically Latvia has reached real independence. In the economy rapid transition from socialistic planned economy to free market principles is underway. This transition is not easy and a lot of difficulties exist as well as mistakes, but already now we can speak about certain real achievements.

The geographical position of Latvia is very favorable to be an important trade link between East and West and historically trade has been a highly developed branch of the Latvian economy.

Latvia is situated between the other Baltic countries and the necessity to cooperate with both neighbors, especially in developing North-South corridors in that part of European Transport network, is evident. To provide the effective functioning of this transport corridor all the actions have to be coordinated and this is already being done.

I TRANSPORT INFRASTRUCTURE OF LATVIA

The basis of the transport system in Latvia is a well-developed network of all modes: maritime transport, railways, roads and aviation (Figure 1). The return of Latvia to Europe gives us great opportunities of economic development, but at the same time increases the requirements, as the transport infrastructure, vehicles and services not always correspond to quality standards of the European Union. Taking in account that Latvia is a transit country - transportation flows are crossing here - it is very important to modernize and widen the infrastructure of transport and communication as soon as possible, in order to provide effective functioning of transport corridors "West-East" and "North-South" and also integrating into a common European transport system .

Transit transport branch is mainly concentrated around three main ports: Riga, Ventspils, Liepaja. Ports are served by a wide railway and road network. Transport infrastructure has all prerequisites to facilitate the development of the economy in the country and to offer wide variety of services for transit freight transportation.

Railway Transport

The total length of railways is 2380 km, 271 km of which are electrified (Figure 2). Density of railways is 0.04 km per square km. Major railway lines are:
- in West - East corridor

Ventspils - Jelgava - Krustpils - Rezekne - Russia border;

Latvia

FIGURE 1.

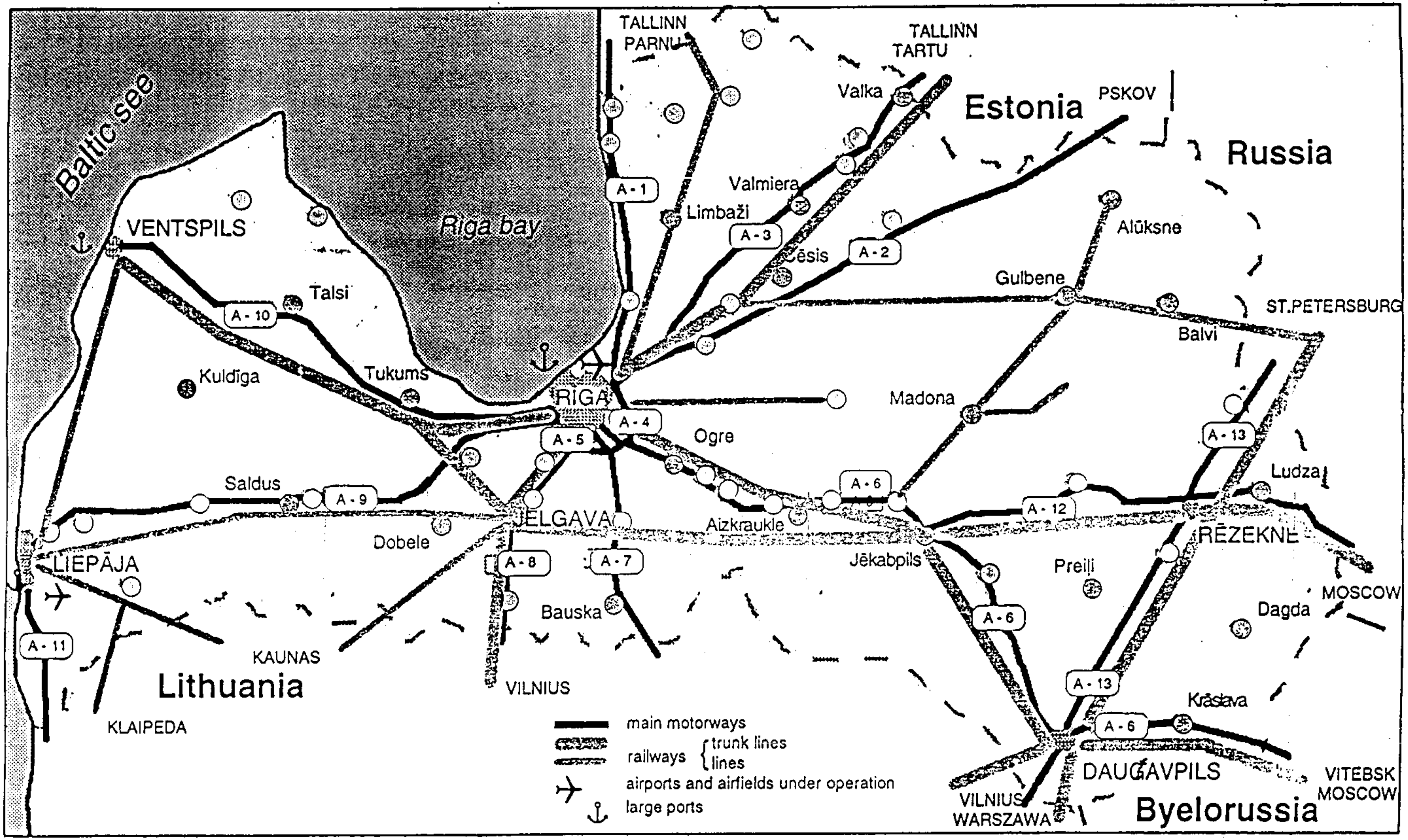
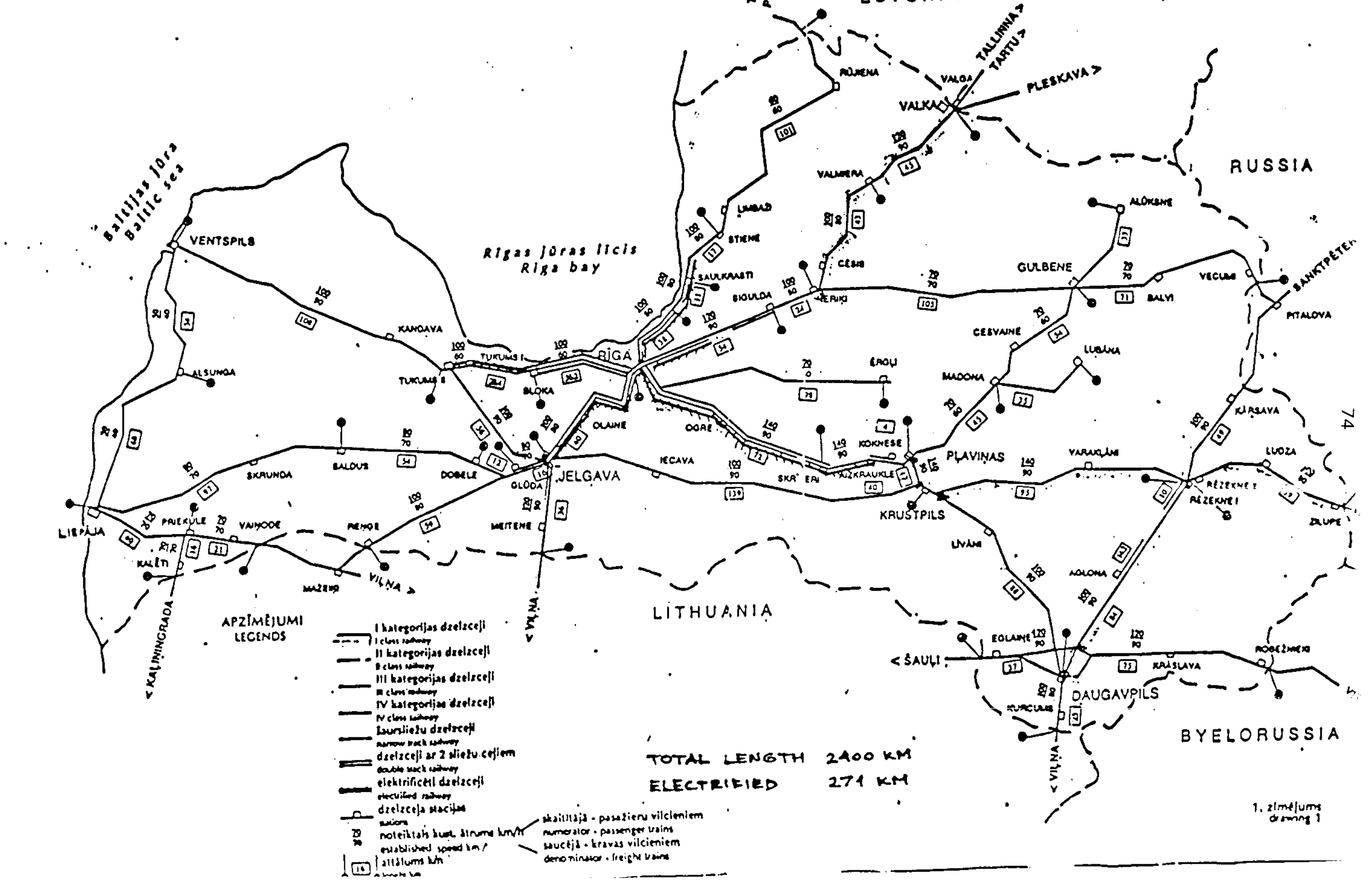


FIGURE 2

LATVIJAS DZELZCEĻU LĪNIJU SHEMATISKAIS PLĀNS
SCHEMATIC RAILWAY PLAN OF LATVIA



- in North - South corridor
  Riga - Krustpils - Daugavpils - Belorussia (Lithuania) border.

In 1994 more than 30 million tons of cargo were carried by Latvian railways and 91% was international traffic, of which 75% transit.
The main factors causing the problems in the various forms of transportation are:
- problems encountered as a result of the transition to market economy as well as complications in settlements of accounts with the countries of the former Soviet Union;
- financial losses in passenger transportation;
- insufficient financing for the maintenance and infrastructure.

In order to improve the performance and quality of service of the railways, reconstructioning of several sections is planned and it will result in increased speed of travel. Another priority are development of railway functions in ports Riga, Ventspils, Liepaja and also reconstruction of port access railways. A study is underway about the feasibility of container block trains between ports and NIS countries.

Roads and Road Transport

The total length of state roads in Latvia is 20 600 km, 7900 km of which are asphalt paved roads (Figure 3). Density of state roads is 0.33 km per square km. Total length of state main roads is 1800 km. There are also 40 000 km of local and municipal roads. Generally the road network is balanced and well-developed, but the main difficulties encountered for the development of the sector are insufficient financial resources, in particular for maintenance.

One of the most important action being considered is the so-called "VIA BALTICA" road improvement project (Latvian section of route is Estonian border (Ainazi) - Riga - Bauska - Lithuanian border). The project includes construction of by-passes and rehabilitation of bridges and asphalt pavement, as well as the development of information systems for road users.

The other important transit route leading to Moscow (road Riga - Jekabpils - Rezekne - Russian border) also needs rehabilitation and possibilities of development of combined transport are essential.

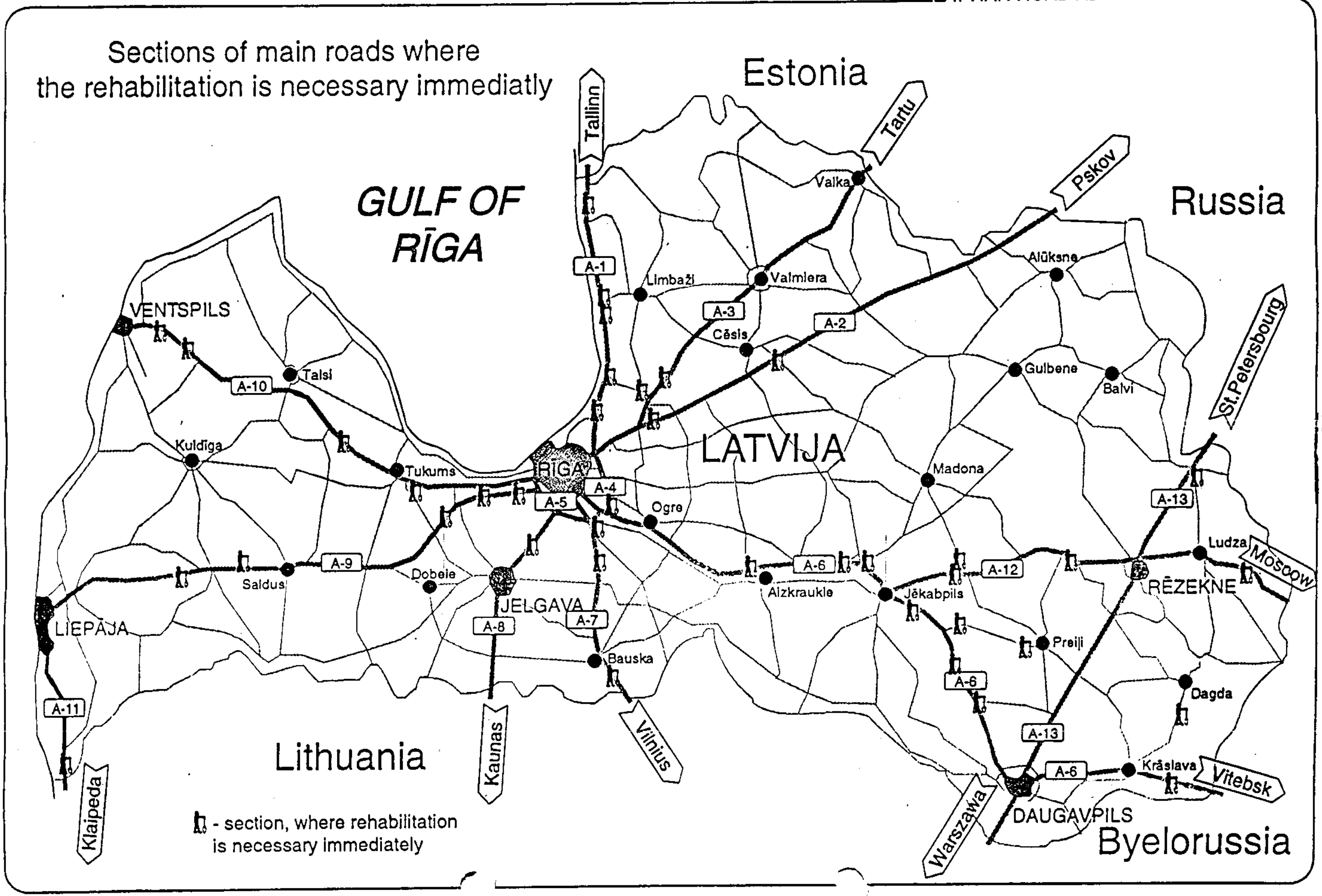
For all state roads the most important project in the nearest future will be the rehabilitation of roads because 20% of them are in poor condition.

In 1994. structure of traffic flow in Latvia was following:
70% - light duty vehicles;
30% - heavy duty vehicles

Expected growth of traffic volume is approximately 5% per year.

FIGURE 3

LATVIAN ROAD ADMINISTRATION



Another important question to be addressed is the road transport, in particular passenger transportation is done by buses. As result of high operating costs and low solvency of inhabitants, the bus fleet has reached its life limit.

The similar situation is also with trucks, which are mainly produced in former Soviet Union and are not economically in maintenance.

The great part of Latvian bus and truck fleet don't answer to requirements of European standards and national economy of Latvia. In present situation with insufficient financial resources in increasing of amount of vehicles predominate take place purchasing of second - hand busses and trucks. In this case of course , not only arise problems with maintenance expenditures, but also is aggravation of traffic safety and influence on ecological conditions.

Total amount of road transport cargoes in 1994 was 32 tons.

The main task on development of road transport are renewal of public transport fleet and improving of transportation processes.

Maritime Transport

Latvia has three main ports - Riga, Ventspils and Liepaja, and seven smaller, which are located along the five hundred km long sea border with the Baltic Sea and the Gulf of Riga. Ports are the main components of the countries transit industry, as more than 90% of handled cargo is transit cargo. To some extent, each ports has its own specialization.

Riga port handles mainly general cargo, containers, coal, metals, fish products. Riga port has increased for a certain amount the handled cargo volumes, mainly containerized cargo. We have to mentioned that Riga container terminal was constructed to be the main terminal for cargoes in the direction Europe - Far East and we believe that these functions will be reestablished.

The Sea Passenger Terminal is also located within the territory of Riga Port. The passenger flows have increased during last two years and three regular lines are operating: Riga - Kiel, Riga - Stockholm and Riga - Travemund.

The biggest port on the Baltic Sea where oil and oil products are handled is Ventspils. It is connected with Russia by two pipelines - one for crude oil and the another for oil products. Specialized cargo handling complexes are operating in the port and they are: oil terminal, complex for liquid chemical cargoes, potash terminal. Existing capacity allows to increase the handled the handled volumes for certain extent, but new development also is foreseen to improve the service and safety.

Liepâja port is presently regaining its commercial port status after having been a navy base for decades. Reconstruction of Liepâja port started in 1992. This port mainly handles timber, metals and containers.

In 1994 an increase in cargo turnover was observed and the total amount has reached 34 million tons. We can forecast the volumes will increase and in year 2000 will reach about 36 million tons and by the year 2010 - 45 million tons.

Common aspects of transport sector development

Discussing the possibilities to gain from the geographical position of Latvia, we clearly understand that the work should be based on long term perspective, looking at all modes of transport as a joint complex. Overall "National Transport Development Program" will be prepared in 1995 with the main goal:
- to provide development of effective transport system, which fully meets the growing requirements of people and national economy for reliable and qualitative transport services and which are fast, secure and for acceptable cost.

The ways how to rich this goal are:
- development of transport infrastructure according to definite standards;
-improvement of transportation process, coordination between sectors and development of combined transport within corridors for international and transit traffic;
- complex development of transport system;
- replacement of rolling stock;
- improvement of traffic safety;
- introduction of progressive technologies in cargo handling operations and development of warehousing;
- provision of systematic education and training for transport specialists, though improving their qualification.

Basic laws have been prepared and accepted and the last one still in preparation is the "Law on Railways". Next important stage will be to adjust Latvian transport legislation to the European legislation. We believe that the work we are doing will give positive results and the name of LATVIA will be well known as a name of reliable and efficient partner in transport and transit operations.

II EMISSIONS FROM TRAFFIC

Emissions from traffic is the biggest part of the total air pollution in country. In Figure 4 is illustrated the situation with air pollution from transport sector in compares to stationer air pollution sources. As you can see, emissions from the traffic (including rail, sea, air and road traffic) are responsible for approximately 68% of total air pollution, 77% nitrogen oxides, 86% hydrocarbons and 86% carbon monoxide.

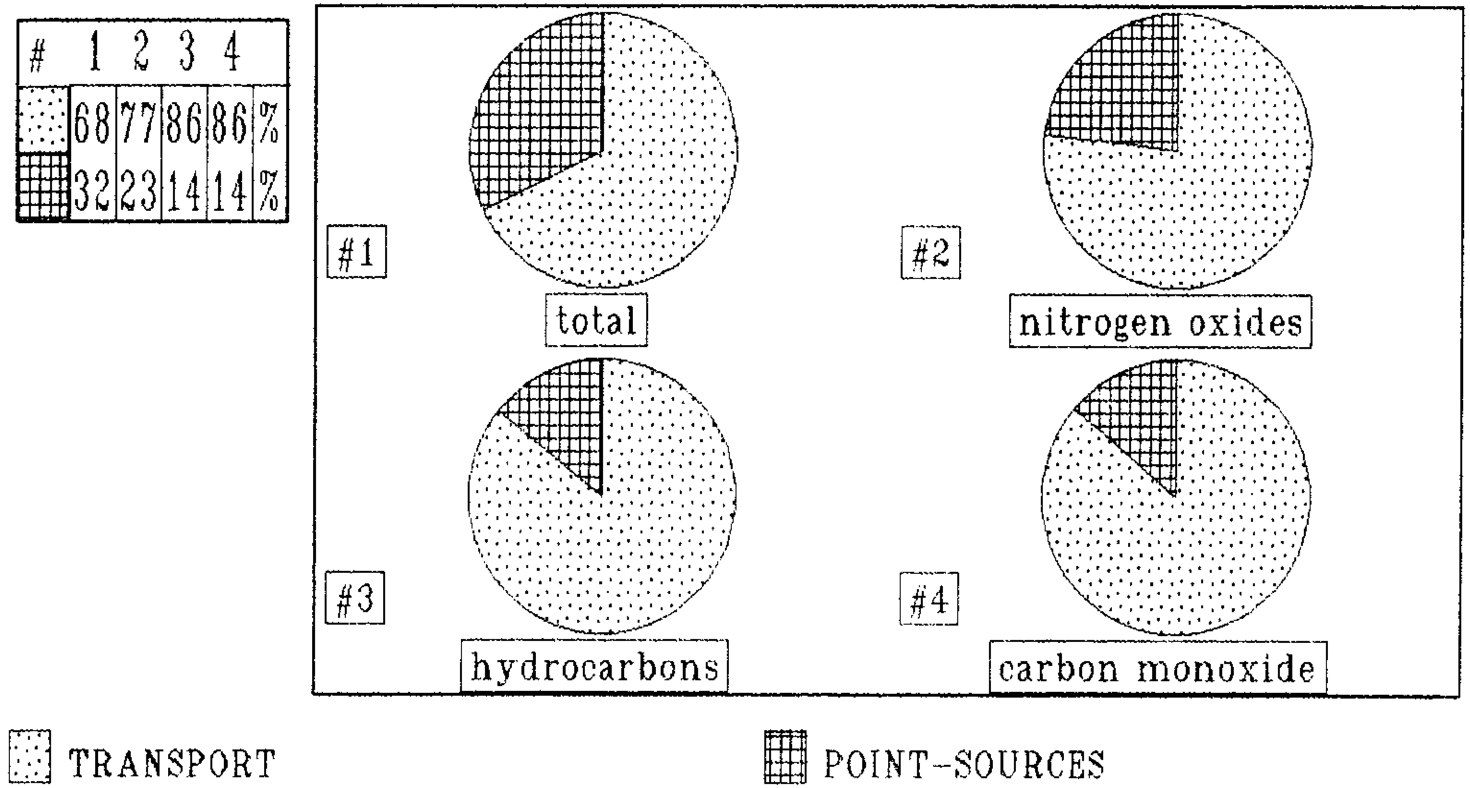
The number of vehicles used in Latvia is rising up continuously (Table 1). Also the forecast shows that this process will increase in the nearest future.

Figure 4

AIR POLLUTION IN LATVIA

1993. year

#	1	2	3	4	
TRANSPORT	68	77	86	86	%
POINT-SOURCES	32	23	14	14	%



Number of vehicles according to years (1990-1993)

Table 1

	1990	1991	1992	1993
Trucks	67.3	70.5	75.0	80.0
Buses	11.7	13.0	18.0	20.0
Cars	282.7	328.4	350.0	391.0
Special vehicles	24.3	24.1	25.0	25.0
Total	386.0	436.0	468.0	516.0

It is expected, that the number of individual cars per 1000 of inhabitants will reach western Europe nowadays level at 2010 (Apr. 280-320 per 1000 inhabitants, at 1993 it was 147 per 1000 inhabitants). It means, that at 2010 number of individual cars will double in comparison of today.

The emission from transport sector (including rail, sea, air and road traffic) shows reducing trends from 1990-1992. It was due to restructuring process of national economy and partly due to complicated access to statistical data in to process of rapid privatization. Now the statistics of emissions show the trend of rise up of emissions (Figure 5,6).

The forecasts for the year 2000 show, that emissions from traffic will increase in near future. The forecasts are made considering three factors:

- increase the number of vehicles,
- decrease the fuel consumption for vehicle according to the using of advanced vehicles,
- increase the number of vehicles supplied by catalysts.

III EMISSION REGULATIONS

Figure 7 displays the histogram of vehicles registered in Latvia according to the year of production. Most of the vehicles that are on the Latvian market are imported second hand ones with an average age of some ten years. It is essential to see how fast the situation changes.

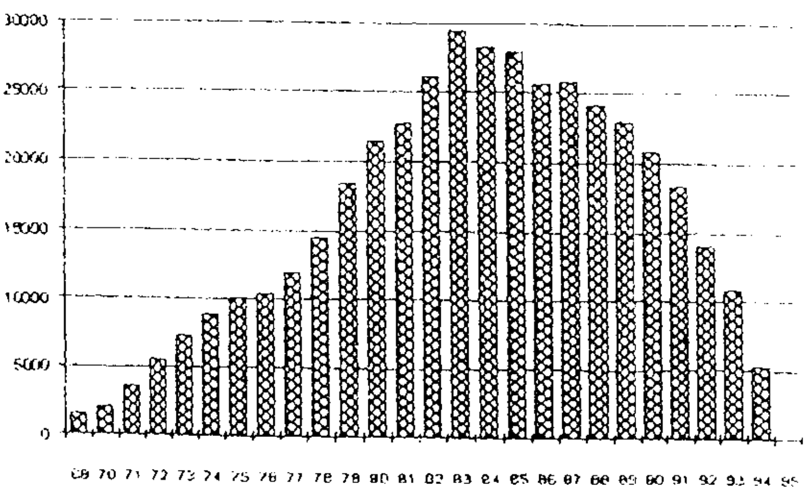
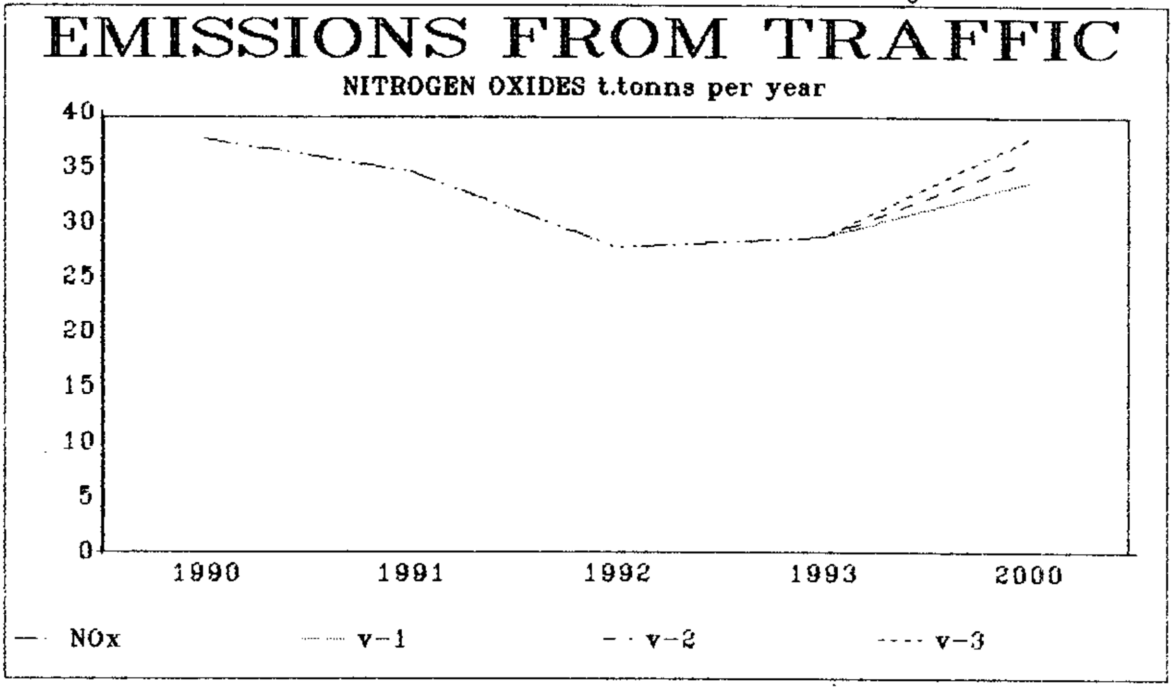


Figure 7

Figure 5.


EMISSIONS FROM TRAFFIC
NITROGEN OXIDES t.tonns per year
40
35
30
25
20
15
10
5
0
1990
1991
1992
1993
2000
NOx
v-1
v-2
v-3

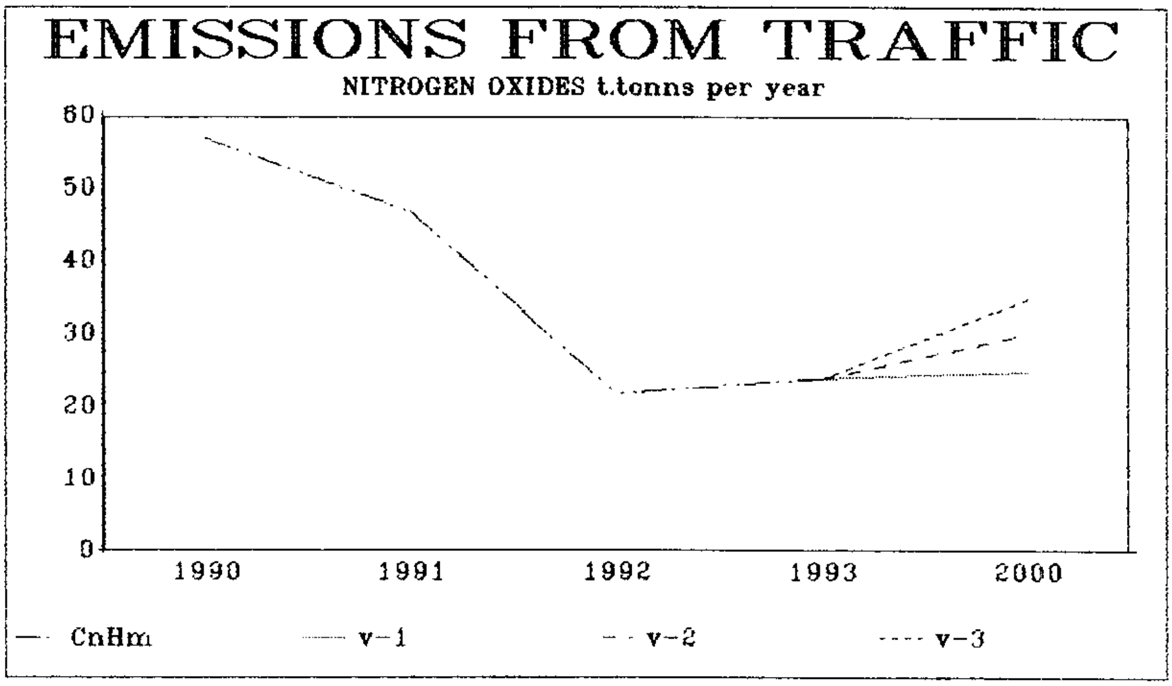
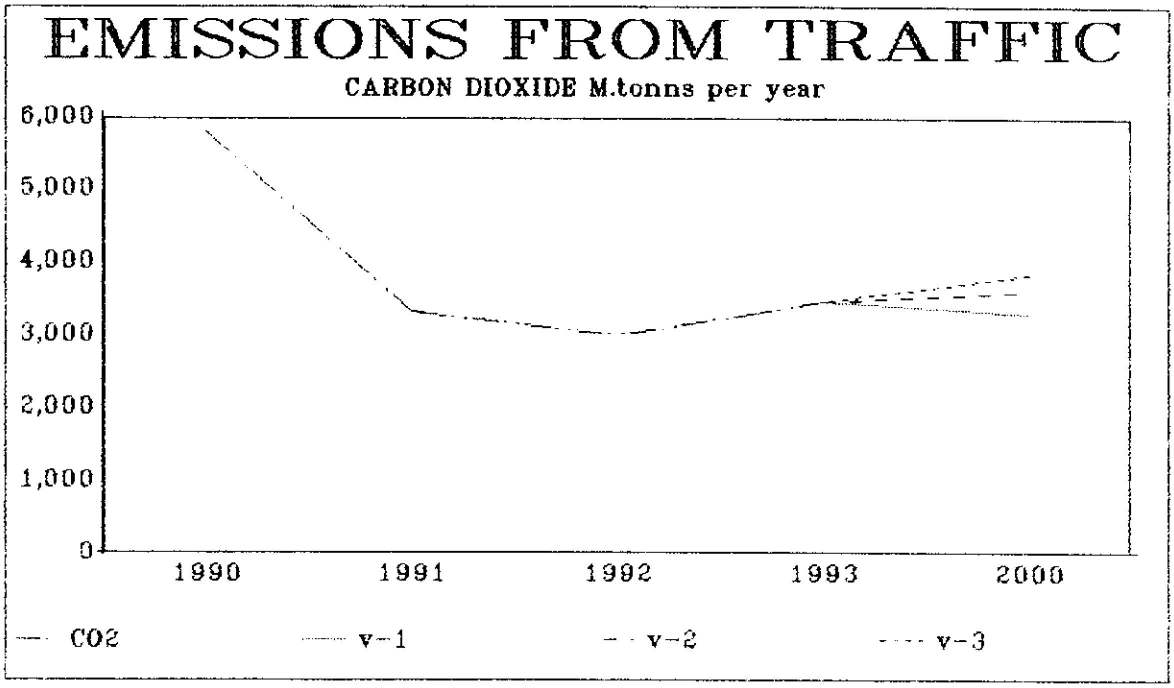
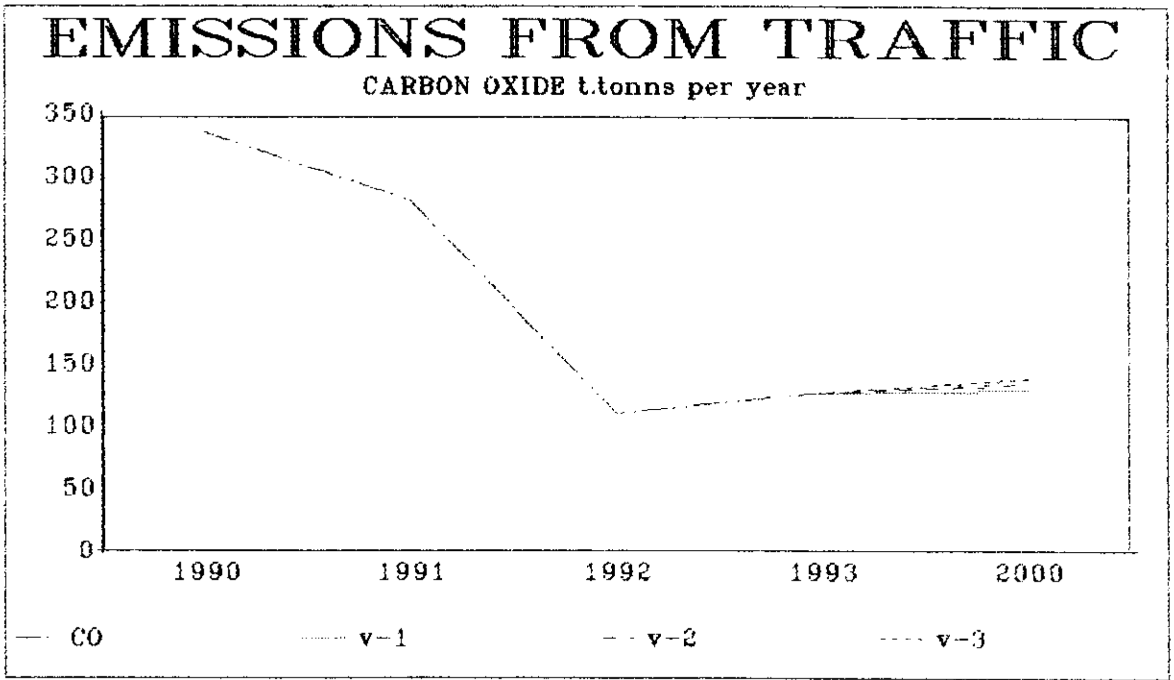

EMISSIONS FROM TRAFFIC
NITROGEN OXIDES t.tonns per year
60
50
40
30
20
10
0
1990
1991
1992
1993
2000
CnHm
v-1
v-2
v-3

Figure 6


EMISSIONS FROM TRAFFIC
CARBON DIOXIDE M.tonns per year
6,000
5,000
4,000
3,000
2,000
1,000
0
1990
1991
1992
1993
2000
CO2
v-1
v-2
v-3


EMISSIONS FROM TRAFFIC
CARBON OXIDE t.tonns per year
350
300
250
200
150
100
50
0
1990
1991
1992
1993
2000
CO
v-1
v-2
v-3

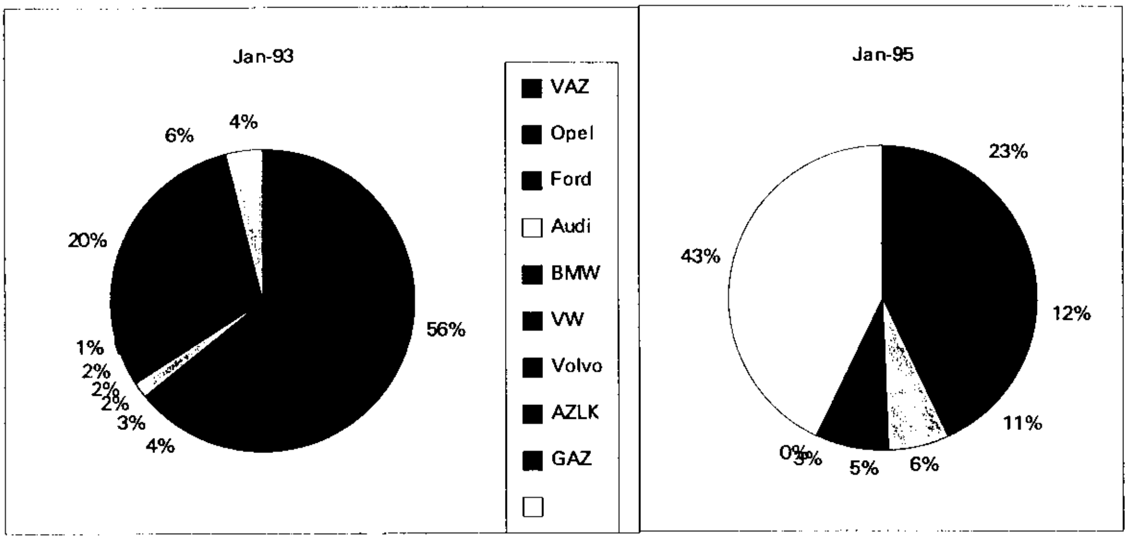


Figure 8

Before 1990 the number of cars that were not produced in former Soviet Union was almost negligible. Figure 8 shows the situation on the beginning of years 1993 and 1995. In 1993 the share of the most popular VAZ (LADA) cars was more than a half. Within two years it has dropped down more than twice. The number of second hand cars imported from west is increased significantly. Although due to the tax policy the speed of increase of the number of old vehicles is slowed down the main goal is still the same: to improve the technical condition of the vehicles that are in operation.

The legislation for vehicles in operation limits the content of CO and hydrocarbons in exhaust gases at idle and at raised idle speed for petrol engines and smoke at free acceleration and at maximal rotation speed for diesel engines. There are no special limits for vehicles equipped with catalysts. More high content of CO at idle is allowed for random inspections (3 % vol.).

The norms for exhaust gases emissions from gasoline engines (Table 2)

Rotation frequency	Max. allowed carbon monoxide concentration (% of volume)	Max. allowed concentration of hydrocarbons (ppm)	
		up to 4 cylinders	above 4 cylinders
idle	1.5	1200	3000
raised idle speed	2.0	600	1000

The norms for exhaust gases emissions from diesel engines (Table 3)

Condition of smoke test	% of smoke, no more
Free acceleration:	
naturally aspirated	40
turbocharged	50
At maximal rotation frequency	15

Emission testing are carried out in two ways:

- exhaust gases emission testing is included into annual technical examination program. This examination program is obligate for all vehicles which are into operation.

- random exhaust gases emission inspection on the roads and streets. These inspections are carried out by the inspectors from Road Traffic Safety Service and Environmental Protection Inspectorate. This inspection program is more active in the urban areas.

It is quite important what we really can do. Until now there was no vehicles testing station equipped with well operated smoke meters and HC metering equipment and the only advantage that smoke is visible. Partially these tests were made by random inspections. All testing stations in Latvia are equipped with CO meters, but until now all the stations were open air so there were problems to do exhaust gases inspections at low ambient air temperature. From January a new car and LCV testing station that will operate through the whole year was opened in Riga equipped with modern technic including 4 gas analyzers from Bosch (CO, CO_2, HC, O_2, l value). It will serve all the city. A new modern testing station for trucks will be opened in the nearest future. This station will serve all the trucks registered in Riga and all the trucks from the whole state that are used in international traffic. A plan for developing the testing stations in other cities is created. From the 1995 the data on technical condition of vehicles will be collected into computerized data system.

Due to the rapid change of models of vehicles that are in operation getting additional education and technical information is essential. Some two years ago there was a large shortage of technical information about vehicles produced in west, advanced engine management systems, etc. This shortage is basically lowered today. It is done not only by importing western information, but also by publishing books, teaching process. A training course for people employed in vehicles testing stations in the whole state will start in February. Of course emissions testing will be included in the training program. Although the percentage of new vehicles in the market is not very high, it is useful to see what the situation is. Figure 9 shows the share of different companies in new car market in the first part of 1994. Although the maximum is for cheaper cars, the share of the most advanced cars is significant. Anyway the technical level of new cars in Latvia will depend on what cars are offered by West European market. There is no equipment in Latvia for carrying out emission test according to European standards.

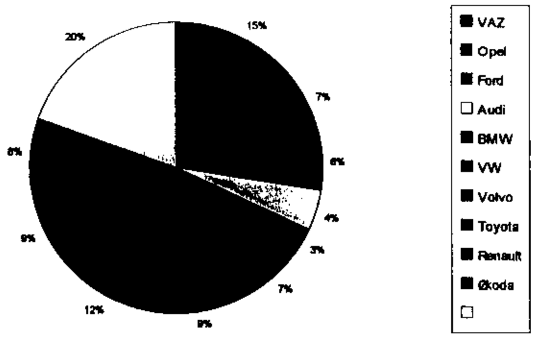


Figure 9

There are not any equipment in operation for measuring the content of NO_x in exhaust gases at all.

As the next step of country activities on controlling the exhaust gas emissions will be gradual adaptation of standards and norms of EU.

IV FUEL QUALITY

The fuel consumption in Latvia increases. Today it seems like everybody is going into the oil business, while petrol stations are mushrooming in Latvia.

The problem of petrol station and fuel quality in respect to the protection of environment is closely connected with the whole traject from crude oil till used oil could be viewed.

In Latvia the mentioned problem most of all is connected with receipt, storage and distribution of fuel by the petrol stations and the consumption of the fuel by vehicles. At a petrol stations the main polluted environmental objects are soil, air, surface and ground waters. It is caused by spills related to the distribution of fuel at the petrol stations and leakage's due to defects of fuel storage and delivery installations. Vaporization of fuel causes emissions into the air.

In Latvia there are two kinds of petrol stations, regular ones and container types. At present there approximately 120 - 150 petrol stations in Riga and approximately 400 - 500 petrol stations in Latvia. It is expected that during the next 2 - 3 years the number petrol stations in Riga will double. Another problem is irregular petrol station distribution in Riga area.

There are regular stations owned by Western companies such as Neste, Statoil and some others. The western companies have equipment of high quality. In return the Latvian companies are equipped with container stations the performances of whose with respect to safety and environmental protection as well as to the quality of fuel is doubtable and probably worse than in the case of the regular stations.

As a positive consequence, from the activisation of fuel market in Latvia, is practical availability of unleaded petrol in the petrol stations.

In Latvia today is problems with the quality control of fuels. It is because of control institutions have not enough equipped with control technics. It means, that in the near future will be difficulties to meet European Standards respecting to Automotive fuels.

Regarding to existing in Latvia technical regulations for petrol stations, we realize that these are not enough strict to meet European Standards.

Therefore, now we are working in order to elaborate technical regulations for:
- arrangement of petrol station for regular and container types; the regular petrol stations must correspond the European technical regulations in this respect;
- equipment's of petrol stations (vapor recovery at petrol stations;
- quality standards of fuel; it means that it is necessary to introduce testing and certification laboratories;
- petrol station regular location.

It could be expected that these technical regulations will be elaborated at the end of this year.

V PROGRAM OF ENVIRONMENTAL TAXES

Now, in Saeima (Parliament) for conformation is project of law "On the Tax of Nature Resources". Into compares with the previous law "On the Tax of Nature Resources, in the new law will be included taxation of fuels. This project is prepared by the Ministry of Environmental Protection and Regional Development of the Republic of Latvia. The objective of the natural resources tax is limiting of mismanagement in the use of natural resources and environment pollution, supporting a sustained development strategy in national economy, as well as creating a financial backing for environmental protection activities.

We expect, this law will be into force at the middle of this summer.

The natural resources tax on consumption of fuel will be applied as indirect tax by analogous procedure of tax administration as applied for the excise tax.

In tax rate for fuels will be included CO_2 and lead taxes. These are the prospective rates of the tax for fuels.

- diesel fuel	0.001 Ls/l	(0.0018 USD/l)
- gasoline		
unleaded	0.003 Ls/l	(0.0055 USD/l)
leaded	0.01 Ls/l	(0.018 USD/l)

Based on the income of this tax, will be possible to establish special purpose funds for different action programs, like catalyst, pollution control programs etc.

CONCLUSIONS

To achieve the Sustainable Transport Policy in the countries of Baltic Sea area, it will be desirable to work out HELCOM recommendations for reducing of emissions from traffic. These recommendations should be acceptable for all region countries taking into account the economical and technological possibilities.

TRANSPORT AND ENVIRONMENTAL PROTECTION IN LITHUANIA

Geographically, Lithuania is situated in the centre of Europe. The point indicating this centre is 20 km to the north of Vilnius, the capital. Thus, Lithuania is a state of Central Europe belonging to the Baltoskandia region. Altogether, Lithuania covers 65.2 thousand km² and the total length of this land border is approximately 1747 km. Compared to other Baltic States, Lithuania has the shortest border with the Baltic Sea coast. The coastline is only 94 km long. There are 722 rivers more than 10 km long. The longest river is the Nemunas, with a length of 937 km. There are 4000 lakes, including 25 lakes with a surface area of over 1000 ha. A favourable geographic situation was one of the main factors determining the historical role of Lithuania in Europe.

The transport system of Lithuania, as the basic element of industrial infrastructure performs a very import role in securing a stable functioning of all branches of the economy. About 13 percent of the basic means of production are concentrated in the Lithuania transport system. The national transport system employs 8 percent of the people working in the sphere of production.

Freight transportation in 1990 amounted to 380 million tons and freight transport mileage 42 000 million ton kilometres. Passenger mileage was 13 000 million passenger kilometres and the number of passengers transported was 730 million. Freight transportation in 1993 decreased to 214 million tons and freight transport mileage was 34 000 million ton kilometres. Passenger mileage was 7 000 million passenger kilometres and the number of passengers transported numbered 530 million.

The transport of Lithuania like the entire economy of the country is in recession. The volume of transported passengers and goods has decreased. However, in the second half of 1993 the situation has stabilized. Positive changes in transport have been determined by the efforts of the Ministry of Transport. Its objectives were to sustain stability in transport system and to develop it.

Railroads are the basic means of transport in Lithuania for long distance freight and passenger transportation. Railways network in service totals 2042 km. It has good connections with other Baltic States and the former FSU republics. A great part of export - import of these countries is transported via Lithuania. By rail, Lithuania has the shortest link between Russia and the Kaliningrad region.

The main disadvantage of Lithuanian rail transport is that it has no direct link with the European rail system.

The Ministry of Transport considers railways to be the most important mode of transport. Now we have 13 100 wagons and 247 locomotives. International passenger and freight traffic from Lithuania to Poland was started and cargo terminal in Sestokai was constructed. The rolling stock undergoes renovation and rolling - stock - repair - centre will be established in Lithuania. Plans for modernization of railway lines in South - North and West - East international transport corridors and for installation of modern railway automatics, communication and electricity supply systems are drawn.

Klaipeda port has both advantages and disadvantages. It has a favourable geographical location.

It is ice-free all year round and it has good connections with the road and rail networks. The disadvantages are as follows: protection for port facilities during storms is not sufficient, absence of and interior roadstead, depth of the canals is inadequate, low technical level of reloading equipment, irrational dislocation of port units the port activities up to now.

There are 46 vessels in Lithuanian merchant fleet totalling 300 thousand tons of dead weight. Three rail handling ferries operate between Klaipeda and Mukran, 14 are dry cargo ships, 17 ships are exclusively for timber transportation, multi-purpose freighters.

There is a water-way between Klaipeda-Hamburg, Bremen. There is regular export freight to other European ports, 20 ships take part in Arctic navigation.

Lithuanian shipping undergoes changes: the fleet is renewed - 4 new ships were purchased, ferry boats are reconstructed and adapted for transportation of passengers and vehicles. New shipping lines are established between Klaipeda - Kiel, Ahus, Flessing. The overall Master Plan of Klaipeda Sea - Port was worked out. Klaipeda Sea - Port Directorate, State Inspectorate on Water Transport Control and Navigation Safety were developed. Rescue Coordination Centre is also in charge of combatting oil spillages. The Nemunas river will be adjusted to navigation of bigger ships.

Air services fly mainly from 3 airports - Vilnius, Kaunas and Palanga. Aviation is the basic means of passenger transportation. Today airlines serve 13 air-routes to the West and 3 to the East. In 1993 a new passenger service terminal was opened in Vilnius. The Lithuanian aircraft consists JAK, TU, AN type aeroplanes and one Boeing.

Airports of Lithuania, according to technical and international standards are not meant for heavy-weight aircraft, exceptions are the former USSR military airports.

Lithuania has a network of roads paved with asphalt totalling 21 thousand km in length, 10 thousand of which is upgraded. For every thousand square metres within Lithuania there is 320 km of asphalt roads and 156 km of upgraded roads. In other words, for every thousand inhabitants there are 5.5 and 2.7 km respectively.

Lithuanian road system will be integrated into the trans-European road network. The Via Baltica motorway will be the first to meet international standards and it will take over a part of the transit traffic between Scandinavian countries and the states of Eastern and Cenral Europe.

In Lithuania, the road and rail network did not increase much these last years and the investment is mainly devoted to maintenance works. However, only 5 percent of the railway lines are electrified and half of the State road network is still gravel surfaced. In the field of transport, the present situation is not yet worrying, mainly due to the low traffic volumes currently observed. Even more, one can say that, since 1989, the situation has improved, due to a substantial decrease of traffic in all transport sectors. However, this decrease is linked to the crisis which accompanies the present transition period. Transport activities will increase again when economic situation improves.

The main environmental issue in the field of transport is atmospheric pollution, which is stated to account for 60 percent of all Lithuanian atmospheric pollution. As for the other environmental effects, this pollution is mainly die to road transport. Noise induced by vehicles in large cities and by airport activities is also significant. Maritime transport generates chronic and accidental pollution in the marine environment, while inland waters and soils are polluted by both road and railway traffic. Transportation of dangerous goods poses some threat to people on and close to transport routes. Movement of fuel oil by rail is a particular problem: accidents involving oils spills are frequent. Finally, waste management, including transport wastes is not yet really effective in Lithuania. Ecological monitoring of transport is still insufficient, in both extent and accuracy.

The stock of passenger cars increased by 255 000 in 1981 to 593 000 in 1993. The average level of motorisation is 150 cars per 1 000 inhabitants.

Transport activities account for about 20 percent of total energy consumption and almost entirely dependent on oil.

In Lithuania between 1975 and 1989, fuel consumption by transport modes increased by 23 percent, with an important drop in 1992. The share of diesel in fuel consumption is about 55 percent. Road transport accounts to 80 percent of total fuel expenditure for all transport modes. Transport in Lithuania is estimated to account for 60 percent of total atmospheric emissions; 85 percent of CO, 70 percent hydrocarbons and 50 percent of NOx emissions.

Road transport is the most polluting 92 percent, followed by railway 4 percent, water transport 3 percent and aviation 0,2 percent. Almost all transport means were produced in FSU. Their low technical level and high fuel consumption induce high emission levels. Tools and supply for their maintenance are also lacking.

The vehicle fleet is now becoming increasingly aged, with little replacement of commercial vehicles recently. Now 30 percent of the cargo vehicles in operation are more than 10 years old.

Until the end of the 1980's, an ethyl-petrol 93 octane number with high lead content 0,35 g/ltr and unleaded petrol 76 ON was used in Lithuania. In 1990 new petrol 92 ON started to be produced with lead content 0,15 g/ltr. The 76 ON petrol amounted to more than 70 percent of the total petrol consumption. The other petrol are quantitatively negligible. Unleaded 92 ON and 95 ON petrol is actually only produced in small amounts. Some petrol is imported from Finland, by the Finnish NESTE Company which also distributes 98 ON unleaded and 99 ON petrol. Diesel fuels are with 0,2 - 05 percent sulphur content.

Regulations on emissions are given by the FSU standard on rates and methods of measuring carbon monoxide content in exhaust gases of petrol-engines vehicles, and standard on norms and methods of measurements of smoke emission for cars with diesel engines.

Technical control is exercised in technical control centres. Inspection of traffic enterprises is carried out every year by the Regional Environmental Protection Agencies. To this purpose, every agency is fitted with CO and smoke opacity measurement materials. Inspectors of agencies impose fines on enterprises exceeding the authorised limits during the tests. In some cases, the complete stop of vehicles is ordered.

Ministry of Environmental Protection introduces charges on environmental pollution. They have been levied since July 1991, under the Law on Taxes on Environmental Pollution.

During 1991, an interministerial study was conducted on the theme TRANSPORT and ENVIRONMENTAL PROTECTION, the purpose being set out the problems in Lithuania and determine measures to improve the situation. The Decree of Government of April 1992 launched the implementation of the programme, giving to the Ministry of Transport the responsibility for its coordination. This Decree fixed a series of measures to be implemented in 1992 and asked for the preparation of an implementation plan, involving several ministries' departments, municipal and regional boards for the 1993 - 1996 period.

The State programme T and EP covers a large range of measures more or less directly linked with transport issues. In general, the principle and objective of each measures given, as well as the conditions of implementation, the period of execution, the competent authorities, the investment costs and a financial assessment of the expected benefits.

The provisions included in the Programme deal successively with:

- the need of transport optimisation, and the possibilities of decreasing transport impacts in market conditions;
- the improvement of construction and maintenance technologies of roads, railways and airports;
- the implementation of urban construction and organisational measures;
- the improvement of road building materials and equipment;
- the control of the ecological situation in the transport field;
- the improvement of transport vehicles;
- the improvement of transport wastes management;
- the improvement of technical supervision and repair of transport vehicles;
- the improvement of fuel quality;
- the improvement of transport safety;
- the measures for decreasing transport pollution and negative effects on health and the environment.

Finally in the last part of the realisation is given, including first some recommendations for regulations on atmosphere protection, then a list of priority directions for implementation of the Programme. The present situation shows considerable delay in the implementation of the State Programme T and EP. The main reason is lack of funds.

The two issues which could merit a significant investment Programme during the next years are the reducing atmospheric pollution by road transport. The fight against atmospheric pollution must be considered as the first priority, due to its large scale nature and the global threats which weigh heavy on the world (greenhouse effects, acid rain, etc.).

The action plan for Lithuania could be built on the following basis:

In relation to vehicles:

* to produce and distribute petrol and diesel fuel in accordance with the EC requirements, with a regular supply and a stable quality;

* to enforce an effective vehicles emission control based on a progressive introduction of EC standards;

* to introduce economic incenctives and to organise information campaigns to encourage a more rapid and widespread introduction of unleaded fuel and clean technology generally;

* to ask for new vehicle import, the best available technology in the reduction of air pollution emissions and with respect to energy efficiency;

In relation to traffic management:

* to encourage optimal use of alternative modes to the private cars in large cities;

* to integrate traffic management measures in the planning of urban areas;

* to develop combined transportation;

In relation to infrastructure:

* to set concrete procedures for the assessment of the direct and indirect effects of transport projects;

* to involve public consultation at different intervals during the planning of projects;

* to develop, in infrastructure construction, techniques and materials which reduce impact on the environment, taking into account safety and cost constraints.

These are the main aspects to be developed in Lithuania.

GENERAL STRATEGY OF THE LITHUANIAN TRANSPORT DEVELOPMENT

Necessity to meet economic reconstruction needs, to increase the exchange of goods as well as of tourism between West and East countries, to stimulate transit flows of freights and passengers through the territory of Lithuania toa great extent determines the following aims of the Lithuanian state transport policy:

* the integration of Lithuanian transport network into the European one, taking the advantage of a convenient geopolitical position for international economic and tourism relations;

* the restructuring of Lithuanian transport law fundamentals in accordance with the requirements of international organisations and corresponding them to international conventions, as well as harmonisation of legal regulation system of the transport legal regulations and standards in EEC and other countries;

* the assurance of active participation of state in order to secure activities of the transport infrastructure objects which have strategic impact on the Lithuanian economy, their reconstruction, updating and the stimulation of possible investment into them;

* the priorisation of the multimodal transportation system development in the transport corridors international transit significance in order to ensure flexibility and reliability of the transport service market;

* demonopolisation and privatisation of economic entities in State transport sector, the promotion of foreign and Lithuanian private capital investments, the development of transport infrastructure and domestic as well as international activities.

The international cooperation is established on levels already and it will be continued in the future;

* Baltic States common transport policy;

* Cooperation in transport infrastructure and activities among Baltic Sea Region countries; international cooperation on European level in order to co-ordinate priorities policy in transport infrastructure development among the European Union, East and Central European countries.

The important event for Lithuanian, Latvian and Estonian cooperation in transport sector was the Baltic States Transport Ministers meeting in Vilnius in July, 1993, with participants from the European Commission, G-24 States and international financial organisations. The result of this meeting was the clarification of common transport policy and the creation of Working Group for cooperation of common transport policy and the creation of Working Group for cooperation and coordination in development of Baltic region transport service market infrastructure.

The second group line in international cooperation on transport policy includes Baltic Sea basin countries - participants of Baltic Sea Region Transport Ministers Conference.

Following tasks are defined for the cooperation on transport policy among Conference countries:

* Baltic region transport systems and the development of common strategy on infrastructure:

* transport systems influence on environment and responsibilities to improve it;

* importance of transport safety issues, in order to harmonise national and international traffic safety legislation.

The third international cooperation level deals with European transport network development policy. The main aim of cooperation on this level is to collect all possible information concerning bottlenecks and other difficult parts in transportation lines as well as to define main international corridors for future modernisation, also to prepare proposals to international institutions on investment into transport infrastructure.

Environmental protection.

In order to improve ecological situation it is necessary:

* to enlarge investment and subsidies for purchasing cleaner vehicles. It is necessary to purchase every year about 200 new freight and passengers vehicles, which could meet international ecological requirements;

* to prepare exploitation criteria for vehicles, fuel and facilities;

* to develop vehicles and transport enterprises control system;

* to develop system of charges for environmental pollution. It should be economically efficient to purchase environmentally cleaner vehicles and technologies;

* to develop transport electrification in bigger towns;

* to develop the technical infrastructure of railway in order to enlarge trains speed and to decrease the risk of accident;

* to develop the system of protection in Baltic Sea and elimination of sea accident sequences;

* to prepare legislation system and to start using dangerous cargo transit rules.

	1990	%	1991	%	1992	%	1993	%
Goods traffic millions of tons carried	382.3	100.0	366.7	100.0	263.4	100.0	214.2	100.0
Road transport	308.2	80.6	295.6	80.7	201.0	76.4	170.0	79.4
Public railways	66.5	17.4	63.9	17.4	56.2	21.3	38.4	18.0
Sea-borne shipping	5.2	1.4	5.2	1.4	4.7	1.5	5.1	2.3
Air transport (th.t)	11.6	0.0	9.6	0.0	3.3	0.0	2.8	0.0
Inland waterways	2.4	0.6	2.0	0.5	1.4	0.5	0.7	0.3
Goods, traffic, millions of tkm performed	42068	100.0	38762	100.0	27772.5	100.0	33809.1	100.0
Road transport	7336	17.4	7019	18.1	4988.5	17.9	6906.0	20.5
Public railways	19258	45.8	17748	45.8	11327	40.8	11030	32.6
Sea-borne shipping	15293	36.4	13839	35.7	11406	40.1	15821	46.7
Air transport	17	0.0	15	0.0	6	0.0	2.3	0.0
Inland waterways	164	0.4	141	0.4	45	0.2	49.8	0.2
Passenger traffic, millions of pass. carried	734.8	100.0	765.5	100.0	671.0	100.0	535.72	100.0
Road transport (buses)	686.1	93.3	726.1	94.8	646.9	96.4	509.1	95.0
Public railways	43.4	5.9	35.0	4.6	21.9	3.3	25.1	4.8
Sea-borne shipping	1.9	0.3	1.7	0.2	0.7	0.1	0.22	0.0
Air transport	3.4	0.5	2.7	0.4	1.5	0.2	1.3	0.2
Inland waterways	-	-	-	-	-	-	15.9	0.0
Passenger traffic, mill. of pass. km performed	12865	100.0	12163	100.0	8907	100.0	6686.3	100.0
Road transport (buses)	6677	51.9	6498	53.4	5213	58.5	3664.6	54.9
Public railways	3640	28.3	3225	26.5	2740	30.8	2700	40.4
Sea-borne shipping	2540	19.7	2429	20.0	950	10.7	310	4.6
Air transport	8	0.1	11	0.1	4	0.0	3.3	0.0
Inland waterways	-	-	-	-	-	-	8.4	0.1

Final Energy Consumption In Different Sectors in Lithuania (in percent)

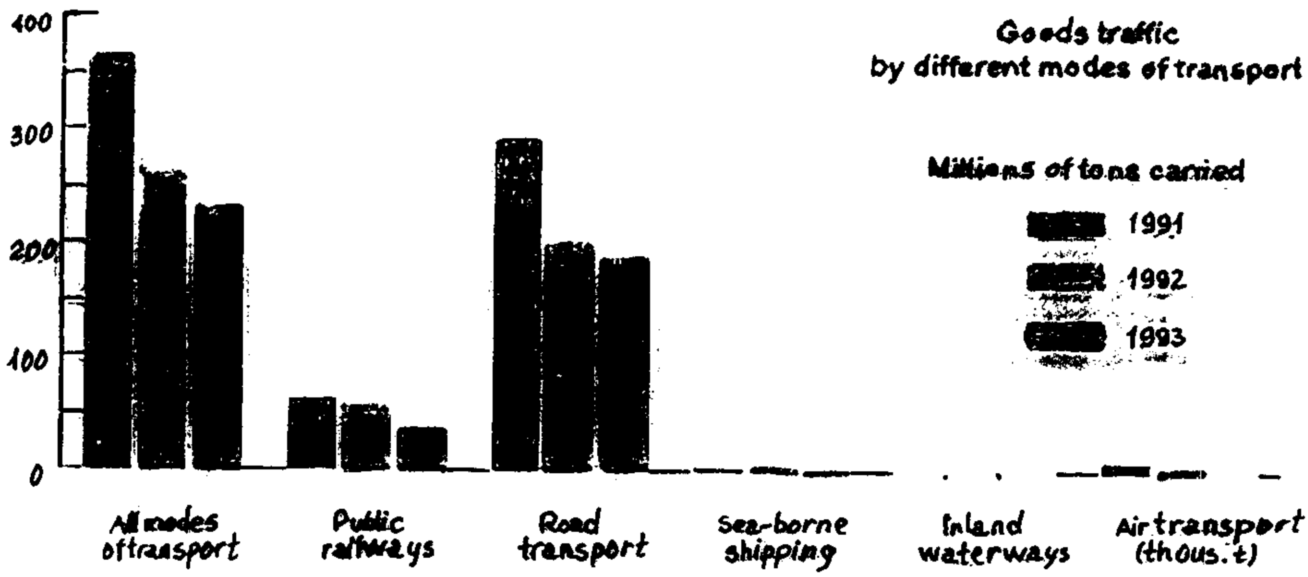
	1991	1992	1993
Industry and construction	33	32	28
Transport	19	21	21
Agriculture	9	8	6
Households	22	22	29
Other consumers	17	17	16

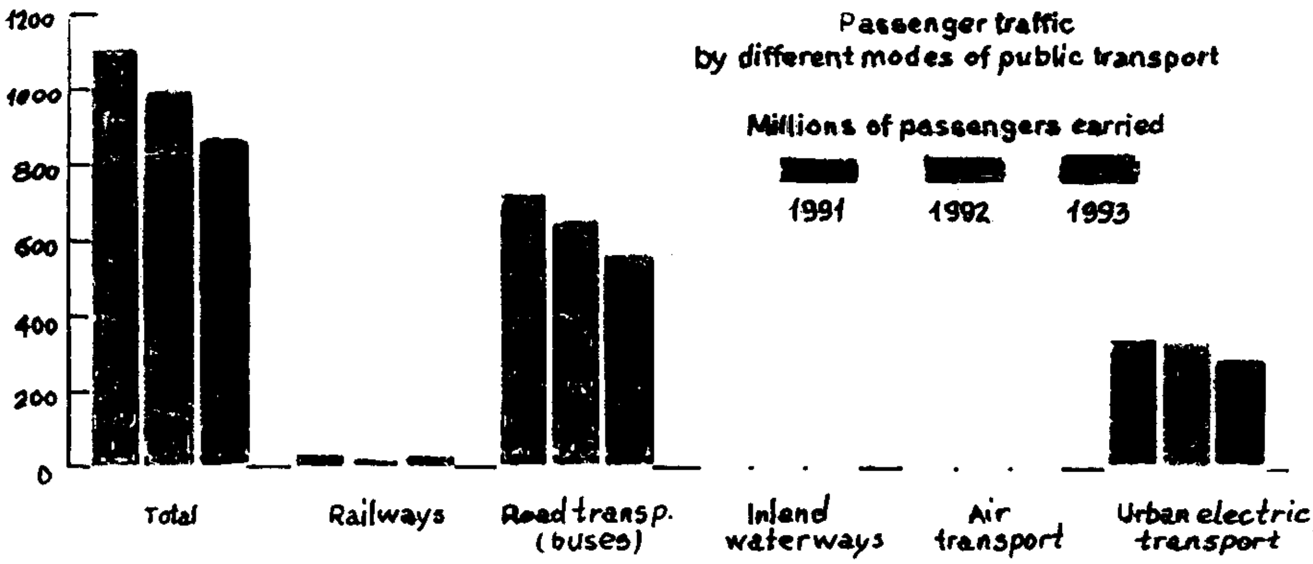
Energy Consumption for all transport modes (ktoe)

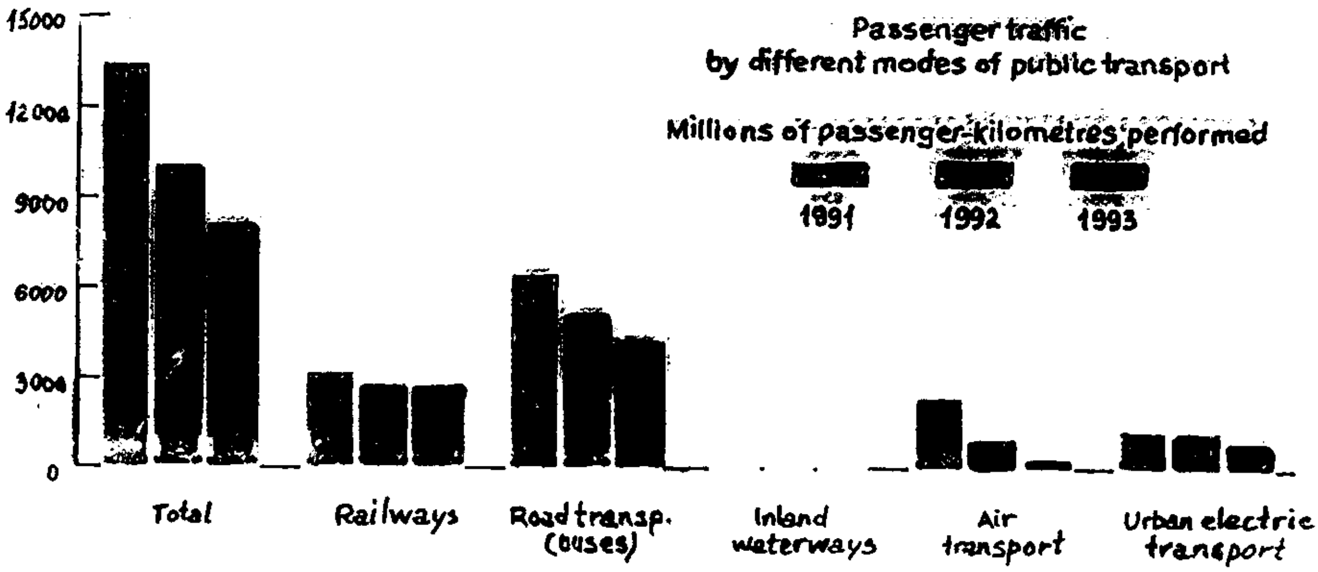
1990	1991	1992	1993
2114	2176	1481	1469

Air Pollution Emissions by Road Transport in Lithuania (thous.tons)

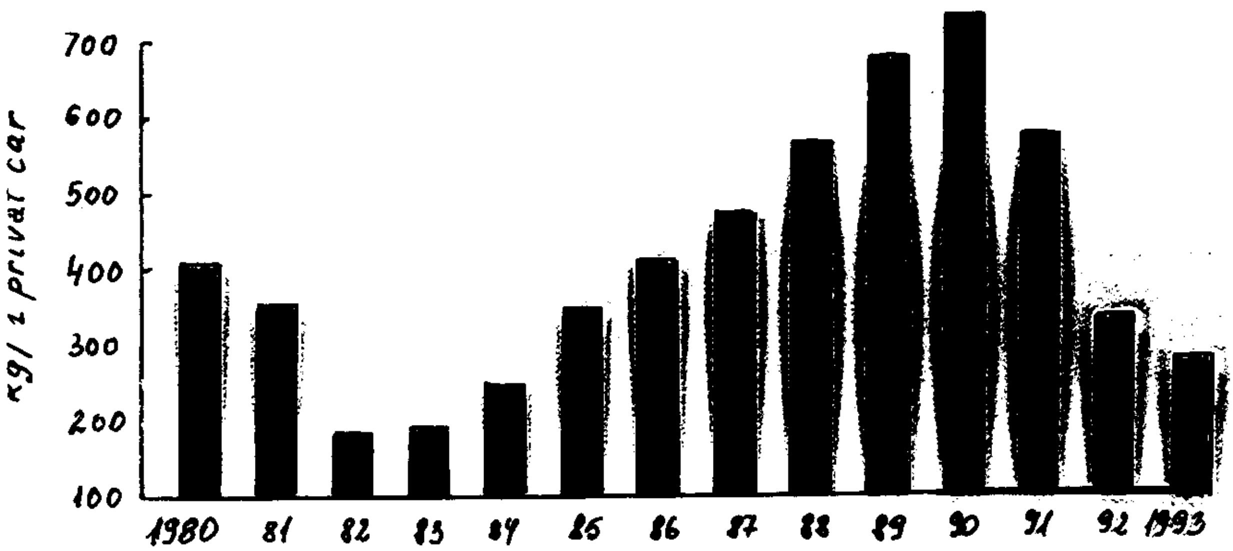
Year	CO	NOx	CH	SO_s	Pb	Solid particles	Total/percent
1990	488.4	32.4	78.8	10.2	0.15	5.3	615.25/100
1991	464.5	47.4	95.7	10.4	0.1	5.4	623.5/101.3
1992	265.5	26.7	58.6	4.4	0.024	2.0	357.324/58.1
1993	293.3	36.8	64.9	4.3	0.023	1.8	401.123/65.2


Goods traffic
by different modes of transport
Millions of tons carried
1991
1992
1993
400
300
200
100
0
All modes of transport
Public railways
Road transport
Sea-borne shipping
Inland waterways
Air transport (thous. t)

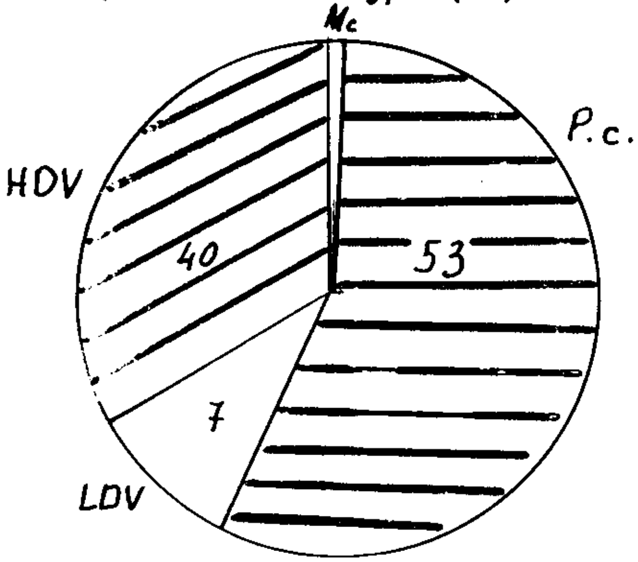

Passenger traffic
by different modes of public transport
Millions of passengers carried
1991
1992
1993
1200
1000
800
600
400
200
0
Total
Railways
Road transp. (buses)
Inland waterways
Air transport
Urban electric transport


Passenger traffic
by different modes of public transport
Millions of passenger-kilometres performed
1991
1992
1993
15000
12000
9000
6000
3000
0
Total
Railways
Road transp. (buses)
Inland waterways
Air transport
Urban electric transport

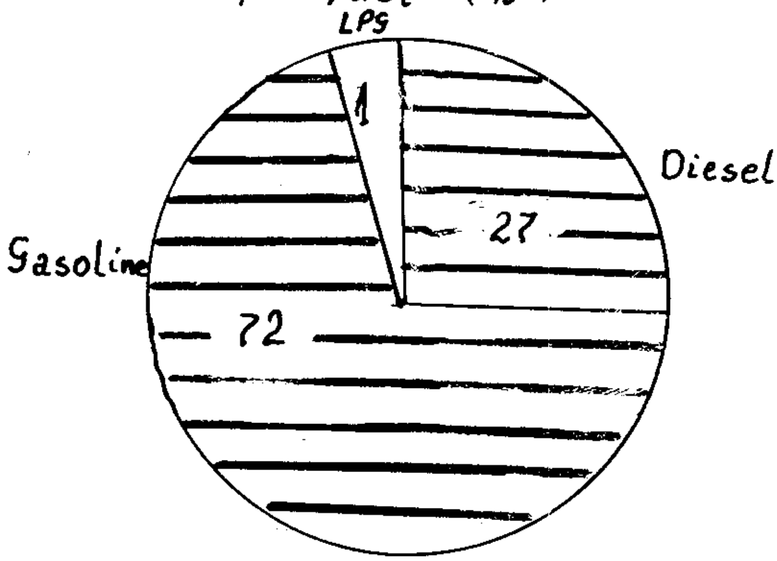
Average fuel consumption 1 priv. car per year



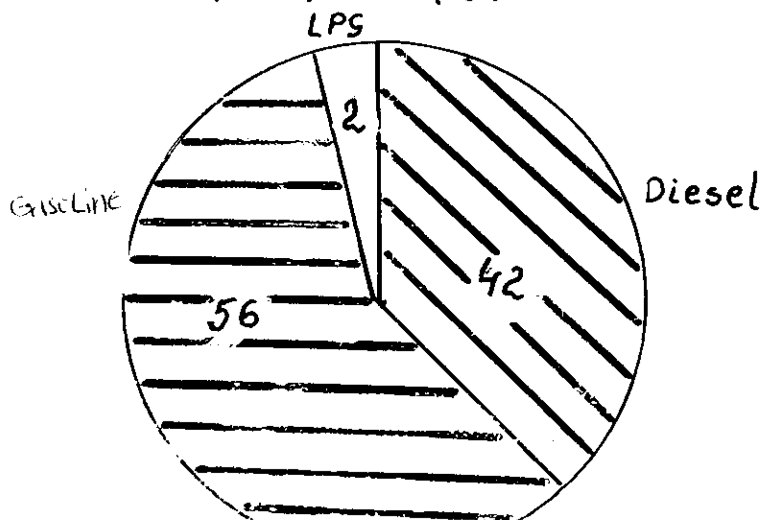
Gasolin consumption per vehicle type (%)



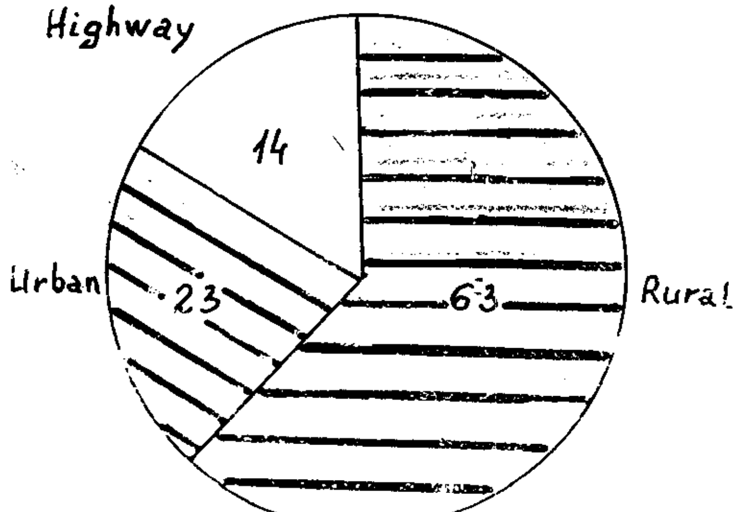
Total CO_2 emissions per fuel (%)



Total NO_x emissions per fuel (%)



Total NO_x emissions per driving mode (%)



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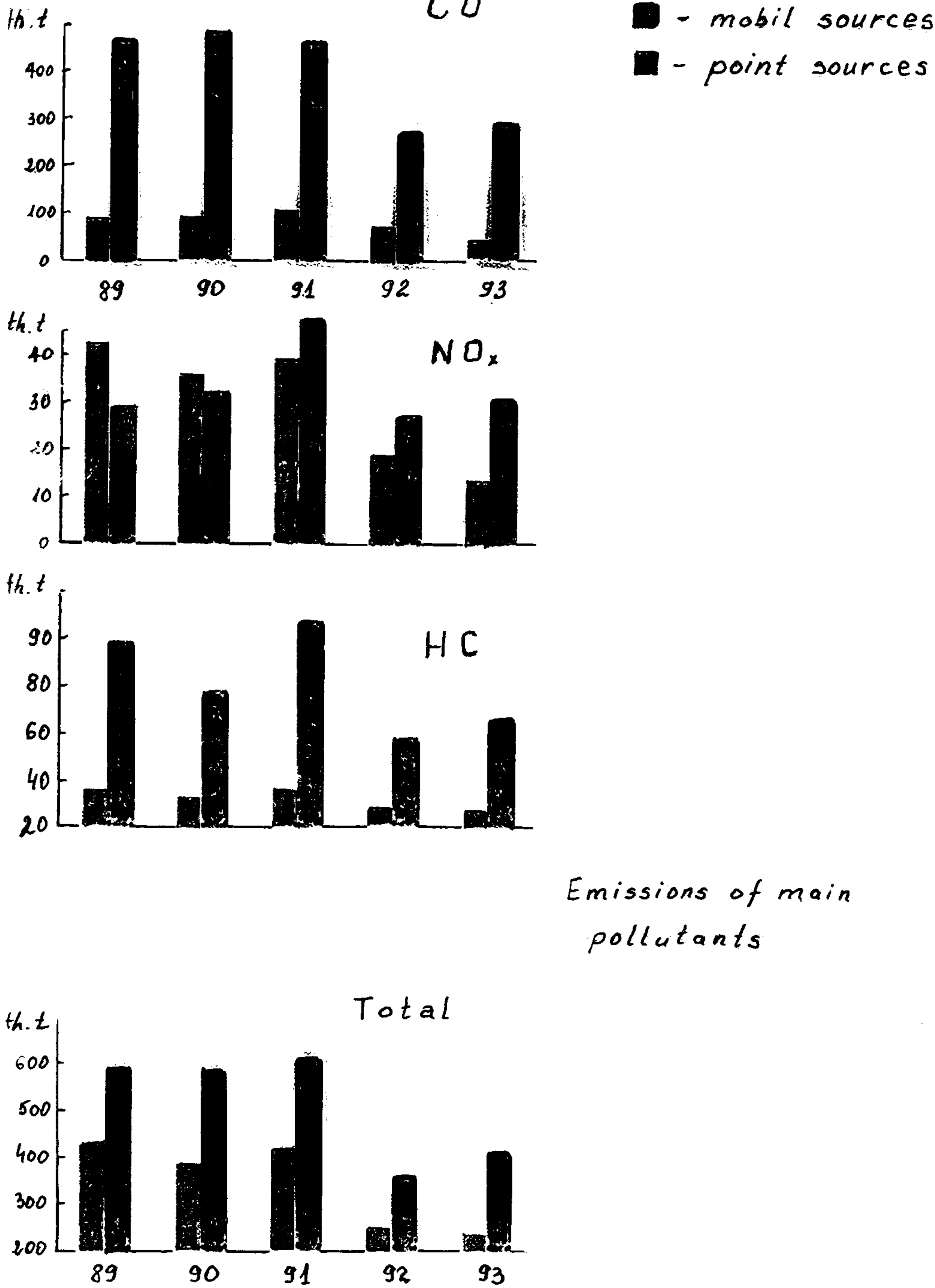

Emissions of main pollutants

**Workshop on the Reduction of Emissions from Traffic
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POLAND: ACTUAL SITUATION REGARDING TRAFFIC EMISSIONS, FUTURE DEVELOPMENT AND MEASURES

BY

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1. INTRODUCTION

Over the last 5 years Poland has undergone great and important transformations. They have taken place in virtually all aspects of activities: political, economic, social etc. Poland has abandoned the path of a centrally planned economy and started the introduction of market oriented reforms. One of the areas where rapid changes have taken place is environmental protection. The approach to its problems has radically changed. The environment has been identified as an area where high priority actions should immediately begin. People are more conscious of the fact that it is not possible to enhance the quality of life without considerable improvement in this area. Strong pressure is laid on decision-making bodies to reduce the air pollution which is a severe burden in many regions of the country. The main polluters have so far been stationery sources, in particular power stations and industrial plants, however adverse environmental impacts resulting from the use of transport are considerable and rapidly growing.

The objective of this paper is:
a) to review the role of transport in the environmental pollution in Poland,
b) to summarize the current transport, in particular motor vehicles, related pollution situation, status of control included,
c) to assess the future development and trends and
d) to propose measures to be taken in order to address emerging problems.

The paper covers the problems related to emissions from:
a) transport means used for transportation of people and goods:
- road transport (motor vehicles - cars, light duty vehicles (LDV), heavy duty vehicles (HDV), motorcycles),
- railways (locomotives),
- water transport (vessels, ships),
- air transport (planes, helicopters),

b) machines, vehicles and devices driven by combustion engines which are only partially or not at all used for transportation purpose,e.g. fishing vessels and ships, agricultural tractors and machines, construction machines, lawn mowers, chain saws etc.

All these vehicles, machines, devices etc. are called for short "transport means". These transport means are fuelled with automotive gasolines, aviation gasolines, diesel fuels, jet fuels, heavy oils, coal and LPG.

The transport classification used in the paper is based on IPCC/OECD methodology [1].

2. CURRENT SITUATION

2.1. Basic information about transport

Table 1 gives information about transport infrastructure.

Table 1

Transport network in Poland (as of December 31, 1992)

Total length of public roads - motorways - expressways	km km km	229 129 257 267
Total length of railroads in service - electrified	km km	25 254 11 496
Total length of inland waterways	km	3 997
Number of airports	-	11
Number of sea commercial ports	-	5
Number of sea fishing ports	-	7

Source: [2]

The number of selected transport means is given in Table 2.

Table 2

Number of selected transport means in Poland (as of December 31, 1992)

Transport means	Number
Passenger planes	39
Motor vehicles - cars - trucks - busses - motorcycles - tractors	 6 505*10^3 1 212*10^3 86*10^3 1 134*10^3 1 183*10^3
Railway stock - electric locomotives - diesel locomotives - electric motor units	 1 354 1 586 1 025
Inland water stock - tugboats and pushboats - passenger vessels	 370 42

Sea going ships - for freight transport - ferries	206 11

Source: [2]

2.2. Role of transport in the air pollution

The transport accounts for only about 8% of the total energy consumption at the end users in Poland, however its contribution to air pollution is more significant. This is illustrated in Table 3. The share of transport in total emissions of main motor pollutants from all sources varies from 33% to 52%. The only exception is sulfur dioxide where this share does not exceed 2%, i.e. is practically negligible.

Table 3

Emissions from transport versus total emissions in Poland in 1992

Pollutant	Total emissions [Gg]	Transport emissions [Gg]	Share of transport [%]
CO_2	397 100	31 850	8
CO	2 500	1 318	52
VOC - NMVOC - CH_4	1 072 1 058 14	349 340 9	33 32 64
NO_x	1 130	458	41
Pb	-	< 1	-
SO_2	2 820	57	2

Source: [3], [4], writers' estimate

The energy consumption and emissions from individual transport subsectors (air transportation, road transportation, railways, internal navigation, international marine and other) is given in Table 4. For road transport, emission factors required for the inventory were estimated on the basis of tests of motor vehicle samples representative for individual types, classes and categories (Section 2.5). For other transport subsectors, they were determined from the technical literature, in particular IPCC/OECD workbooks [1]. They were "customized", as far as possible, to local conditions.

Table 4

Fuel consumption and emissions from individual transport subsectors in 1992

Type of transport	Fuel consumption [Gg]	Emissions [Gg]			
		CO_2	CO	HC	NO_x
Air transport	317	999	4	< 1	4
Road transport	7 074	22 303	1 172	272	302
- cars	2 953	9 310	685	152	86
- light duty vehicles	1 113	3 509	286	47	34
- heavy duty vehicles	2 639	8 321	134	39	167
- motorcycles	99	221	38	21	< 1
- tractors	270	851	13	2	14
Railways	221	733	7	3	12
Inland navigation	37	117	1	< 1	2
International marine	1 130	3 530	9	7	66
Other	1 322	4 169	126	59	73

Source: [4]

The largest source of emissions is road transport (motor vehicles). Its share in the total emissions from the transport sector varies from 66% to 89%. The important one is international marine but its emissions is mainly discharged outside the Baltic Sea area. The share of air transportation, railways (due to electrification) and internal navigation is very small and do not exceed the uncertainty of the estimate for the road transport.

Emphasis in this paper is placed on road transport because of its predominant role in air pollution.

The contribution of motor vehicles to air pollution in the largest Polish cities is significantly higher than it appears from figures given in Table 4. It is estimated that the share in carbon monoxide, nitrogen oxides, hydrocarbons and lead exceeds in general 65%. In extreme cases these pollutants come almost entirely from motor traffic origin.

The air pollution level in several Polish cities is already high. Surveys conducted regularly in cities with population greater than 100 000 show that air quality standards in some of them are regularly exceeded, in particular for nitrogen oxides, lead, carbon monoxide, xylene and benzo-a-pyrene.

2.2. Motor vehicle population and its use

Since 1970 the vehicle population has in Poland continuously grown as illustrated in Fig. 1. As this growth started from a very low level the current per capita vehicle registration is in Poland low by Western standard. The difference is particularly high in the category of cars where Poland, with its 176 car per 1000 people (1993), is on the average delayed by about 20 years in relation to Western Europe.

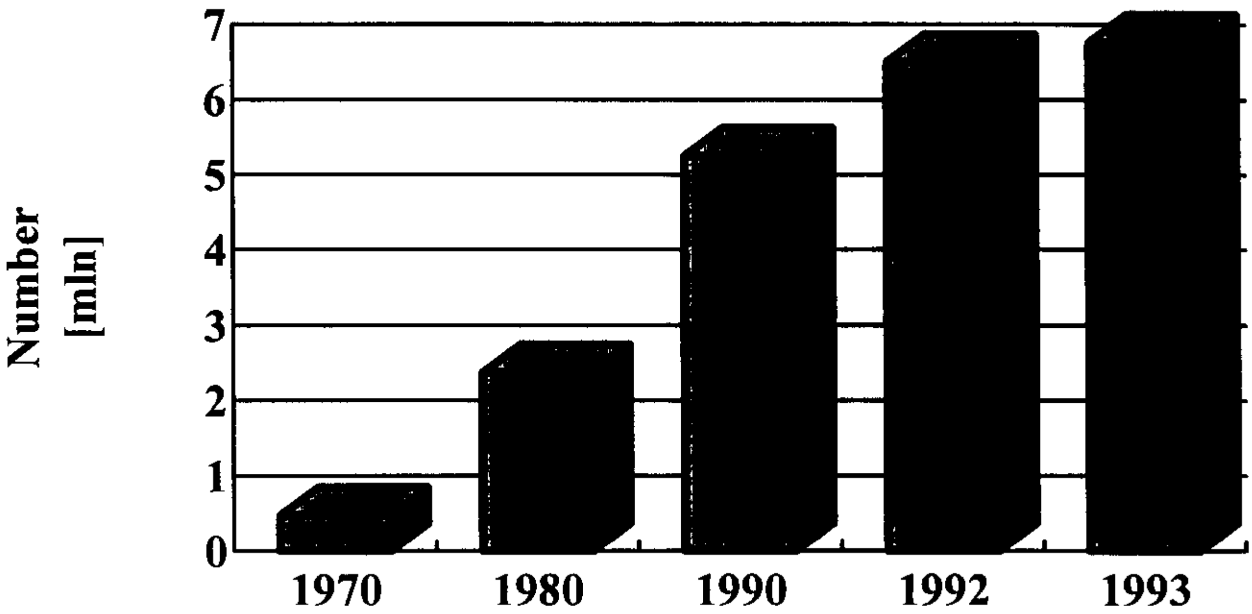

Fig.1. Growth of car population in the period 1970 - 1993.

The majority of vehicles being currently in use has come from domestic production (Table 5).

Table 5

Breakdown of Polish car population by origin in 1992

Origin	Share [%]
Domestic production	67
- FIAT 126p, Cinquecento	35
- FIAT 125p, Polonez	24
- other	8
Former COMECON	18
Other (Western Europe, Japan, USA)	15

Source: [5]

As regards cars, the share of domestic production vehicles is about 67%. Most of them belong to two families originating from the Polski FIAT 125p and Polski FIAT 126p types. The remainder has come from the former COMECOM countries (about 18%) and import from the West (about 15%). The share of domestic production in the category of light-duty vehicles and heavy duty vehicles is on the similar order.

Up to 1989 the import of vehicles from Western countries was relatively low. The main reason for its limited extent was the difference in prices. The situation has changed since 1990. In extreme 1991 year the share of Western vehicles in the new annual registration exceeded 50%. In the majority of cases the imported vehicles were second-hand ones, often damaged in road accidents and rebuilt in Polish repair stations, or removed from traffic due for instance to environmental reasons. The following administrative and economic measures have been taken in order to prevent the dumping of old vehicles in Poland:

- the ban on importation of two-stroke vehicles,
- the ban on importation of cars older than 10 years and trucks older than 3 years,
- the ban on importation of damaged vehicles,
- the introduction of increase import duty and border tax.

These measures have considerably reduced the importation of second-hand vehicles, in particular cars (Table 6).

Table 6

Structure of vehicle registration in Poland

Vehicle category	Year	Total registration [units]	Share of import [%]	
			new	second-hand
Cars	1991	734 885	17.0	52.3
	1992	471 026	16.1	34.6
	1993	477 353	19.7	29.1
Trucks	1991	100 893	8.3	57.8
	1992	71 639	7.9	41.6
	1993	71 098	8.3	40.7
Busses	1991	2 945	8.8	34.7
	1992	2 748	7.1	26.0
	1993	3 144	7.7	29.2
Motorcycles	1991	17 476	36.2	28.3
	1992	11 079	20.3	46.9
	1993	8 611	14.3	47.0

Source: [2]

Certain characteristics of the Polish vehicle population are especially harmful to the environment. One of them is a long life before scraping. It grew rapidly in the eighties and at present e.g. for cars exceeds 16 years on the average. Another one is a significant population of two-stroke cars. In Poland the production of two-stroke cars was discontinued almost 15 years ago, however the import of Trabants and Wartburgs continued up to the early nineties. It is, however, important to note that the annual VTK for old vehicles is relatively low and decreasing. For two-stroke cars it is estimated to be on the order of 3300 km as compared with about 7200 km on the average for the whole car population. Many old vehicles included in statistics are not used any longer.

The use of the main motor vehicle categories and classes, in terms of VKT, is characterized in Table 7.

Table 7

Estimate of annual VKT of selected motor vehicle classes and categories in Poland in 1992

Vehicle class/category	VKT/unit [km]	Total VKT [km*10^6]
Cars	7 200	46 900
- four stroke gasoline engines	7 200	39 700
- two-stroke gasoline engines	3 300	2 100
- diesel engines	15 300	4 800
Light duty vehicles	13 800	11 100
- four stroke gasoline engines	13 700	8 600
- diesel engines	17 800	2 400
Heavy duty vehicles	20 400	11 500
- gasoline trucks	3 000	500
- diesel trucks	24 700	8 300
- diesel busses	35 800	2 700
Motorcycles	2 400	2 700

Source: [4]

2.3. Current status of emission control.

The only group of transport means which undergoes the control with regard to emissions is motor vehicles. The motor vehicle emission control is part of the overall roadworthiness control. The outline of the control system is shown in Fig. 2. The vehicles being introduced for the first time into service (new registration) are divided into two groups:

a) vehicles subject to type approval,

b) vehicles exempted from type approval.

The group a) includes new vehicles supplied in a quantity exceeding three units a year. The group b) includes:

- new vehicles imported in smaller quantity,
- vehicles assembled/manufactured locally in smaller quantity (e.g. from genuine spare components/parts),
- second-hand imported vehicles.

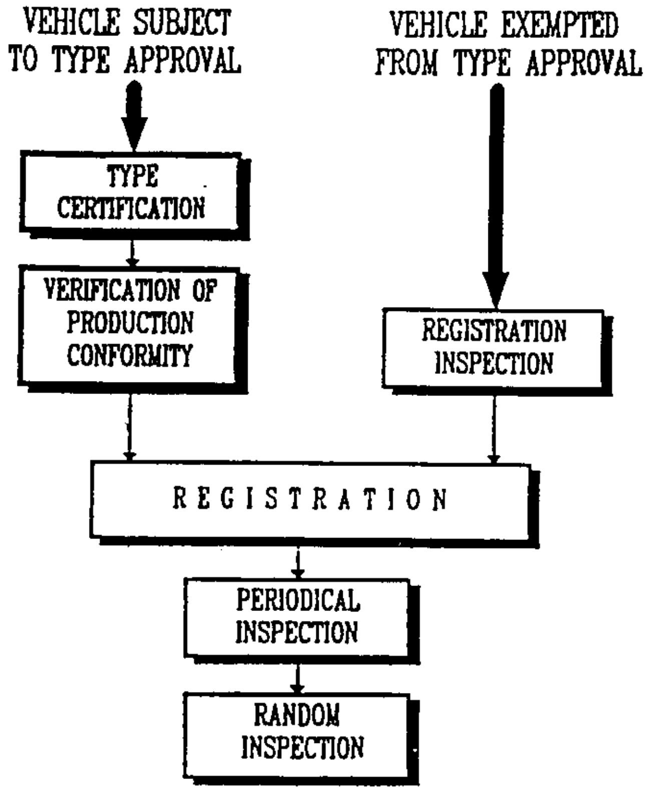

Fig. 2. Motor vehicle emission control system

The group a) of vehicles is subjected to the type approval and to a limited extent to conformity od production (COP) verification. Vehicles of this group are not subjected to registration inspection.

Vehicles of group b) are inspected prior to the registration and their registration can be granted only if they meet the set requirements, emission requirements included. For this group the emission requirements are identical as for in-use vehicles (see later).

The first emission standards for new vehicles were introduced as early as in the mid-seventies. They applied to smoke from diesel vehicles (based on ECE Regulation 24, initial version) and to cars and light duty vehicles (up to maximum mass of 3500 kg) equipped with SI engines (based on ECE Regulation 15, initial version). The latter one was amended in 1981 when the requirements based on ECE Regulation 15, 02 series of amendments were introduced. As regards new heavy duty vehicles, Polish standards based on ECE Regulation 49 , initial version were promulgated in 1984. These standards were in force until 1992. In November 1992 Poland adopted the ECE emission regulations: 24, 40, 47, 49, 83. At present (as of 1 January 1995) the following motor vehicle emission requirements are in force:

- Regulation 24, 03 series of amendments (24.03),
- Regulation 40, 01 series of amendments (40.01),
- Regulation 47, initial version (47.00),
- Regulation 49, 02 series of amendments (49.02),

- **Regulation 83, 01 series of amendments (83.01).**

Regulation 83.01 specifies two sets of requirements for cars (M1 category) fitted with SI engines: lenient one for vehicles fuelled with leaded gasolines (Approval A) and stringent one (Approval B equivalent to Directive 91/441/EEC) for vehicles fuelled with unleaded gasolines. Poland has not specified yet which classes of vehicles must run on unleaded fuel and therefore both the options are applied. The option to select the type of approval (A or B) lies with the vehicle manufacturer.

The above requirements are only applicable to new types introduced into service after the dates of entry of a given regulation into force. To get the approval granted the vehicle manufacturer/dealers has either to produce the emission compliance certificate pursuant to a given regulation or have the vehicle tested in the authorized technical service.

In accordance with Road Traffic Act all in-use motor vehicles are subjected to technical inspections. The inspections are performed periodically , their frequency depending on the category and application, e.g. for cars covered by the type approval certificate the sequence is: 3 years, 2 years and every year, for cars not subjected to type approval - every year and for busses - every half a year.

The emission standards for in-use vehicles, equipped with both SI and diesel engines, were introduced as early as in 1986, however it practice they were only partially implemented due to a shortage of equipment: exhaust gas analyzers and smokemeters. In principle, since 1991 all inspection stations (altogether more than 2500) are equipped with the required instruments. The equipment used in inspection stations has to be type approved.

The current emission requirements to be met by in-use motor vehicles in Poland came into effect in May 1993. They replaced the old one having been in force since 1986. The new regulation is applicable to the following vehicle categories: cars, LDV, HDV, motorcycles, agricultural tractors and slow-moving machines.

For vehicles equipped with SI engines the CO concentration at idle should not exceed:

i) for vehicles first registered before October 1, 1986:
- motorcycles - 5.5% vol.,
- all other vehicles - 4.5% vol.,

ii) for vehicles first registered on or after October 1, 1986:
- motorcycles - 4.5% vol.,
- all other vehicles - 3.5% vol.

For vehicles equipped with CI engines the smoke level measured at free acceleration from low idle speed should not exceed:
- naturally aspirated engines - 2.5 m^{-1},
- turbocharged engines - 3.0 m^{-1}.

The revised regulation specifying new stringent emission requirements for vehicles have already been promulgated. It will be applicable to vehicles of M1 and N1 categories equipped with SI engines first registered on and after July 1, 1995. The new requirements are as follows:

- the concentration at idle should not exceed 0.5% for CO and 100 ppm for HC (as C_6 NDIR),
- the concentration at raised idle speed (in the range 2000 - 3000 rpm) should not exceed 0.3% for CO and 100 ppm for HC,
- excess air equivalence coefficient (lambda) measured at the raised idle speed (in the range 2000 - 3000 rpm) should be in the range of 0.97 - 1.03 (for vehicles equipped with three-way catalytic converters).

These requirements are similar to those specified in Directive 92/55/EEC with the exception that HC limits are additionally set. The limits for HC has been introduced to make it more difficult for vehicles exempted from type approval to meet the requirements during the registration inspection without being fitted with catalytic converters.

Fuel consumption requirements for cars and diesel engines used in heavy duty vehicles with maximum mass exceeding 3500 kg are in force since the late eighties. The new types falling into these categories have to obtain a certificate of compliance with energy requirements from the Ministry of Industry and Commerce.

2.5. Motor vehicle emissions characteristics

With regard to emission levels the current motor vehicle population can be classified as follows (rough estimate for 1993):

a) cars

- uncontrolled (including all two-stroke cars) - 25%,
- meeting Regulation 15.00 - 15.04 (most types only type I and III tests) - 74%,
- meeting Regulation 83.01 (approval B and C) - ~ 1%,

b) light duty vehicles

- uncontrolled - 40%,
- meeting Regulation 15.00 - 15.04 (most types only type I and III tests) - 59%,
- meeting Regulation 83.01 (approval B and C) - < 1%,

c) heavy duty vehicles

- uncontrolled - 50%,
- meeting Regulation 24.00 - 24.03 and Regulation 49.00 - 49.01 - 48%,
- meeting Regulation 49.02 - < 1%.

The VKT of old vehicles being low (Section 2.3), the contribution of uncontrolled vehicles to the emissions is much lower than their share in the total vehicle population.

The standard of vehicle maintenance in service is relatively poor and efficiency of inspection with regard to emissions from in-use vehicles is low. Many vehicles do not comply with the standards (Section 2.4), though the requirements are lenient. The share of vehicles non-complying with the carbon monoxide limit is estimated to exceed 40%. The corresponding figure for smoke level is about 20%. The non-compliance percentage is similar to that in the early eighties (prior to the introduction of emission inspection). The effect of the non-compliance is especially high in urban traffic. It is estimated that efficient inspections would be capable of emissions reduction in the largest cities on the order of 10 - 20% for carbon monoxide, hydrocarbons, smoke and particulates.

Average specific emissions of selected motor vehicles in service are estimated in Table 8. It is important to stress that the figures given in Table 8 are estimated for real operation conditions in Poland, such factors as technical state of vehicles, traffic characteristics, for instance the share of both urban and extra urban traffic, their speeds, the share of individual vehicle categories in both traffic types, and atmospheric conditions being taken into account. Emissions from all vehicle sources, i.e. exhaust system, fuel system and crankcase are included.

Table 8

Emission factors for selected motor vehicle classes

Motor vehicle class	Emission factor [g/kg]		
	CO	HC	NO_x
Cars:			
- gasoline four-stroke engines	250	48.2	32.2
- gasoline two-stroke engines	327	222	6.6
- diesel engines	19	6.4	12.6
Light duty vehicles:			
- gasoline four-stroke engines	307	49.2	34.8
- diesel engines	19	7.0	12.6
Heavy duty vehicles:			
- trucks with gasoline engines	337	50.0	35.9
- trucks with diesel engines	33	12.8	67.0
- busses with diesel engines	56	16.2	57.1
Motorcycles	546	296	6.5

Source: [4]

2.6. Fuels

The breakdown of fuel consumption and emissions from the transport sector by fuel type is shown in Table 9. Transport means operated with automotive gasolines, mainly motor vehicles, account for about 80-85% of carbon monoxide and HC emissions. The largest source of NO_x emissions is transport means fuelled with diesel fuels. Their share exceeds 60%.

Table 9

Breakdown of fuel consumption and emissions by fuel type [%]

Fuel type	Fuel consumption		Emissions			
	Mass	Energy	CO_2	CO	HC	NO_x
Automotive gasoline	39,09	39,68	39,14	85,52	82,02	26,11
Aviation gasoline	0,02	0,02	0,02	0,16	0,01	0,00
LPG	0,05	0,05	0,05	0,06	0,04	0,03
Jet fuel	3,11	3,13	3,12	0,12	0,07	0,86
Diesel fuel	48,66	48,49	48,72	13,58	16,26	61,47
Heavy oil	8,93	8,54	8,84	0,55	1,59	11,51
Coal	0,15	0,08	0,11	0,00	0,01	0,03

Source: [4]

Unleaded gasoline (RON 95) meeting the requirements of EN 228 is readily available in the market and its use is gradually going up. It accounted for:

- in 1991 - < 2%,
- in 1992 - 9%,
- in 1993 - 12%,
- in first half 1994 - 25%.

According to the Polish Standard in force the maximum permissible lead content in leaded gasoline grades is 0.15 g/l and sulfur in all grades - 0.1% m/m.

As regards diesel fuels, the new Polish Standard, which came into force in 1993, specify the sulfur limit of 0.3% m/m. The actual values are lower due, among others, to tax incentives. Prior to the introduction of new requirements they averaged 0.55% m/m, ranging from 0.3 to 0.8% m/m. City diesel oil, intended in particular for use in the public urban transport, has been developed and introduced in the market. The main properties of this fuel are:

- cetane number - 50,
- cetane index - 48,
- density - 0.800 - 0.830 kg/l,
- final boiling point - 300^0C,
- sulfur - 0.2 m/m (to be further reduced).

All Polish automotive fuel standards are legally binding.

To promote the production and use of cleaner fuels, the economic instruments in the form of tax reduction are used, e.g.:

- for unleaded petrol the tax reduction is about 2 US cent/liter which results in the retail price differential between leaded and unleaded grades of about 4%,
- for leaded gasoline-ethanol blends the tax reduction is about 5.5 US cent/liter,
- for diesel fuel, every 0.1% m/m decrease in sulfur content below the mandatory limit of 0.3% m/m results in tax reduction by 0.6 US cent/l,
- engine lubricating oils produced with use of minimum 10% recycled oils are tax-free.

2.7. Other measures

Investment projects in Poland are required to comprise the assessment of positive and negative environmental impacts, including the specifications of outlays for special objects, equipment and services to neutralize negative impacts. Environmental Impact Assessment is required for every essential infrastructure investment. It is a base for the issuance of the permission for investment to be realized. Depending on the environmental effect of the investment the decision is taking on local, regional or governmental levels. Below are listed some investments in transport sector for which the positive decision of the Minister of Environment, Natural Resources and Forestry is needed:

- motorways, expressways, trunk highways,
- long distance railroads,
- airports,
- inland waterways and harbors,
- sea commercial ports.

In Poland, fees are levied on companies/individuals conducting economic activities for so called "economic" use of environment. As regards the transport sector, such fees are paid for emissions of pollutants from transport means as well as for gasoline pumping operations. As regards pollutants, the following ones are included: carbon dioxide, carbon monoxide, nitrogen oxides, hydrocarbons, lead and sulfur dioxide.

In order to promote the use of clean technologies some local authorities have started to introduce the reduction of motor vehicle property tax on vehicles fitted with catalytic converters. The extent of this action has, however, been relatively small up till now.

Loading information centres to reduce the number of empty hauls exist and are developed.

3. FUTURE POLICY, DEVELOPMENT AND MEASURES

3.1. General principles of environmental and transport policies

Poland, a country confronted with serious ecological problems, faces the very difficult tasks of reshaping its environmental policy during a time of radical changes in the national economic system. The new policy departs from what was once a narrow understanding of environmental protection to a broader goal of sustainable development and the reconciliation of multiple objectives i.e. the attainment of a balance between social, economic, technical and environmental conditions in the process of development. Sustainable development policy is based on such principles as:

- control at the source in accordance with the following priority order: avoidance of pollution generation, recycling and neutralization of pollution;
- polluter pays;
- regionalization, i.e. increasing the role of local- and regional authorities in managing the environment;
- common solution, i.e. international cooperation, in particular with neighbor countries, in the solution of common environmental problems;
- staging of long term plans.

It is a duty of the state to ensure and control that the transport is developed and used in a proenvironmental manner. Environmental goals in the development of transport shall be achieved primarily through improvement of public transport systems and promotion of "clean" transportation systems with regard to pollution as well as noise. This refers to both the transport means and reloading devices. Manufacturers of transport means have to satisfy standards of emissions, energy consumption and noise levels.

Requirements to be satisfied by transport objects will be established in the context of cooperation between Ministry of Transport and Maritime Economy with the Ministry of Environment, Natural Resources and Forestry. It will be ensured that these requirements are met in all phases of the system construction.When establishing the ranking list of most urgent transport investments, indicators of environmental changes after the completion of a given investment and its putting into service will be taken into account. Projects ensuring environmental neutrality or improvement of environmental conditions will be submitted to the Finance Minister with recommendations for fiscal incentives.

The gradual harmonization of the Polish legislation with that in force in European Union will be one of the principal tasks in the area of transport sector in years to come. The national strategy, policy and programs will be further adopted to control and reduce emissions in accordance with the Convention on Long-Range Transboundary Air Pollution and its protocols concerning the control of emissions of nitrogen oxides and sulfur.

3.2. Development of transport infrastructure

The development of combined transport for goods is one of the main objectives of the Polish transport policy. The selection of combined transport technologies will be correlated with European tendencies in the development of such technologies, priority being given to moderately capital absorptive ones. The investment in the rail infrastructure , including the construction of new terminals properly equipped for fast and efficient change of transport means will be supported with a view to transporting 12 - 15% of freight in this manner. Emphasis will be placed on the introduction of combined transport for goods transit through Poland.

The second important area is the modernization and development of road transport infrastructure. It is planned to have constructed toll motorways of a total length of 2500 km and expressways of 3500 km by about 2010. Environmental Impact Assessment of this large investment is under preparation. Furthermore, measures to make a more effective use of existing infrastructure e.g. traffic calming in urban areas, dedicated lanes for public transport, the construction of by-passes and ring road in order to reduce and avoid transit traffic and congestion in urban areas as well as widening of most heavily used road sections are envisaged and will be implemented as far as financial resources make it possible.

3.3. Motor vehicles

It is projected that the growth of motorization in Poland, in particular private cars, will continue at a current rate or even faster in years to come. It will result in a considerable increase of the vehicle population, VKT and fuel consumption. Projections for the year 2000 and 2010 are given in Tables 10 - 11.

Table 10

Projections of motor vehicle park in 2000 and 2010

Vehicle category	Number by fuel used (1)					
	2000			2010		
	Gasoline	Diesel	Total	Gasoline	Diesel	Total
Cars	7 812 8 788	588 662	8 400 9 504	10 440 13 590	1 160 1 510	11 600 15 100
Light duty vehicles	616 717	317 370	933 1 027	525 730	641 893	1 166 1 623
Heavy duty vehicles		645 670	645 670		748 845	748 825

(1) Upper number - minimum projection
Lower numbers - maximum projection

Source: [6]

The measures already taken up (Sections 2.4) and the planned development of infrastructure (Section 3.2) have not the sufficient potential to offset the environmental impact of the motorization growth. Additional, comprehensive and integrated measures are required for this purpose.

Following measures are deemed to be necessary to improve the situation:

a) the setting of more stringent emission standards for new vehicles, in particular the provision that vehicles of M1 and N1 categories fitted with SI engines must run on unleaded gasoline and should meet the requirements specified for Approval B in Regulation 83.01 and its consecutive series of amendments, adoption of the requirements specified in Directive 93/59/EC for N1 category (Regulation 83.02) and specified in Directive 94/12/EC for M1 category (Regulation 83.03);

b) the introduction of enhanced enforcement procedures to ensure the full compliance with the limits, in particular the establishment of a provision that all new vehicles should meet emission requirements in force at the date of their first introduction into service;

c) gradual phasing out of vehicles exempted from type approval and introduced into service only on the basis of preregistration inspection;

d) improvement of inspection and maintenance programs with a view to reducing the share of vehicles non-complying with the in-use CO/HC standards to about 10% and smoke standards to about 5%;

e) further improvement of fuel quality;

f) increased removal of old vehicles from service, among others through economic incentives.

Projections of emission of pollutants for the year 2000 and 2010 for the scenario that some of the mentioned measures are introduced are given in Tables 11.

Table 11

Projections of fuel consumption and emissions from motor vehicles in 2000 and 2010

Motor vehicle category	Fuel consumption [Gg}	Emissions [Gg]			
		CO_2	CO	HC	NO_x
Year 2000					
Motor vehicles	12 170	38 372	1 164	243	475
- cars	5 670	17 878	645	123	104
- light duty vehicles	1 570	4 950	324	34	56
- heavy duty vehicles	3 470	14 094	86	28	264
- other	460	1 450	109	58	51

Year 2010					
Motor vehicles	19 540	61 610	723	142	406
- cars	10 780	33 989	246	40	65
- light duty vehicles	2 160	6 810	323	34	65
- heavy duty vehicles	6 140	19 359	66	23	251
- other	460	1 452	88	45	25

Source: writer's estimate

It is expected that, as compared with 1992, the emissions of CO, HC and SO_2 will slightly decline in 2000 and considerable drop in 2010, but those of NO_x will increase. It is, however, important to note that the projections were prepared in 1993 and did not take into account the impact of all envisaged measures e.g. development of combined transport and construction of motorways as well as the introduction of requirements specified in Directives 93/59/EC and 94/12/EC. It is estimated that all the envisaged measures will result in much higher reduction and will make it possible to contain by 2010 all emissions below 1992 levels.

4. CONCLUSIONS

In Poland, the transport account for a significant portion of air pollution in the macroscale of the whole country and particularly in big cities. The largest source of emissions in the transport sector is motor vehicles. As the rapid growth of motorization is expected to continue in years to come, the air pollution problems will continue to deteriorate unless more comprehensive, high priority actions ensuring much greater control than is currently in place and the improvement of infrastructure are not taken as rapidly as practicable.

In order to offset the growth in vehicle population and VKT the state of the art emission control technologies should be phased in. Much more emphasis should be placed on the enhancement of in-use vehicle I/M programs. Road transport demand management measures, among others the development of combined transport, are required to complement policy based on technological advances and technical standards.

It is expected that the implementation of the envisaged measures will result in containing the growing trend in transport emissions by 2000 and reversing it in the next decade.

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Workshop on the Traffic Emissions in the Baltic Sea Area
Rostock-Warnemunde (Germany)
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RUSSIA: TRAFFIC EMISSIONS IMPACT ON THE BALTIC SEA AREA STRATEGY AND PRACTICAL STEPS

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Contents

Foreword

The transport system is an important factor in the social and economic development. According to the UNEP data the number of automobiles in world over the past 20 years has doubled and is expected to further double during the next 20 or 30 years. The production of automobiles is currently concentrated essentially in highly developed industrial countries. OBSE countries are producing at percent 88 percent of the world automobile production and share 81 percent of the world automobile fleet. The number of automobiles in Western Europe reaches 200-400 per 1000 inhabitants [1].

Transport requires large volumes of natural resources and absorbs lands needed for construction of automobile roads, railways, marine and river ports, airports. This sector consumes also mineral resources and metals required for productions of automobiles and creations of infrastructures and consumes considerable quantities of energy.

In countries experiencing economic problems the construction of new roads is constrained and in a number of cases the situation is even worse because of the low level of operating services.

Very often the use of lands for the purposes of transport sector (construction of highways, railways, marine or river ports, airports etc.) enters in conflict with other kinds of land use.

The European countries have joined their efforts in setting some common targets for pollutions reduction, particularly in freezing NOx emissions, and elaborating appropriate measures to solve NOx-related environmental problems. [2]

Domestically produced NOx and VOCs emissions are an important contributor to the ground level ozone problem and much efforts should be made to solve domestic NOx and VOCs related environmental problems to meet international obligations, with due consideration for other related air pollution control programmes, including the acid rain control programme and anticipated future programmes for control of greenhouse gas emissions.

In addition to their contribution to the formation of the secondary ozone (O_3) product, both NOx and VOCs are pollutants having the potential to cause other adverse environmental and/or health effects.

Methane is another long-lived VOC which contributes to the greenhouse effect. Even though it has a very low reactivity, methane is also a major contributor, along with NOx, to the observed long-term buildup of background tropospheric ozone.

VOC Emissions, 1985 and 2005, thousands of tons

Source	1985	2005	% Change
Mobile			
On-Road Vehicles	614	402	-35
Off-Road Vehicles	91	109	+20
Marine	28	32	+13
Aircraft	10	13	+31
Railroads	7	6	'-14
Total Mobile	749	561	-25
Total Stationary	1104	1486	+35
Total	1854	2047	+10

Sulphur emissions have to reduced by 60-90 percent to cut the load on the existing ecology system and bring it to the allowable levels. NOx and VOCs emissions should be reduced by at least 75 percent. That means that transport emissions in the advanced countries should be reduced by 80 percent on the average.

High temperature processes in internal combustion engines emit a number of heavy metals, besides the combustion of leaded gasolene remains so far a major source of lead emissions accounting for 62 percent of all such emissions, followed by 26 percent non-ferrous metal production emissions calculated on the basis of emission factors as it is currently adopted.

A study of heavy metals pollution rates on the atmosphere gives the following estimates:

Overview of Sources Categories

Industrial and Utility Combustion	important source
Mobile Sources	major source
Primary Iron and Steel Production	important source
Primary Lead Production	important source

Since early 70s studies of the alternative fuels has being conducted. Some countries use natural gas as motor fuel in a compressed or condensed form.

Fuels and Energy Resources

Transport consumes about 30 percent of all energy consumption, and 82 percent of all extracted oil. East Europe and the Commonwealth of Independent States (CIS) spend about 13 percent of all consumed energy on the transport sector.

The main sources of energy known at present are coal, oil and gas, the world production of which account for 30, 40 and 20 percent respectivly, with 10 percent remaining for other sources of energy [3].

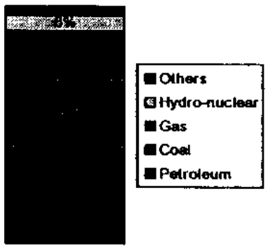


Figure 1. Sources of Energy

Over the whole history of the mankind it has been extracted about 120- 130 billion tons of conventional fuel (equivalent caloricity of one ton of conventional fuel is equal to 7,000 kcal/kg, i.e. 2/3 of the caloricity of petrol or kerosene), including 45 billion tons of petroleum. Of these quantities, 60 percent of fuel, 80 percent of oil and practically all natural gas have been produced for the past 30 years.

The level of oil production in Russia and the former USSR, 1991-1993, billions of barrels per day [4].

	Russia			The former Soviet Union		
	1991(1)	1992(2)	1993(3)	1991(1)	1992(2)	1993(3)
Gross extraction	9.27	8.0	7.0-7.2	10.37	9.0	8.0-8.3
Oil	9.03	7.8	6.8-7.0	9.95	8.6	7.6-7.9
Condensed Gas	0.24	0.2	0.2	0.42	0.4	0.4
Oil processing	5.75	5.1	4.4-4.6	9.09	7.2	6.1-6.4

	Russia			The former Soviet Union		
	1991(1)	1992(2)	1993(3)	1991(1)	1992(2)	1993(3)
Oil products						
Bunker Oil	1.76	1.6	1.4-1.5	3.00	2.3	2.0-2.1
Diesel	1.46	1.3	1.2	2.2	1.9	1.6-1.7
Gasolene	0.91	0.8	0.7	1.40	1.2	1.0
Jet Fuel	0.35	0.3	0.2-0.3	0.54	0.4	0.3-0.4
Others Oil products (4)	0.24	0.4	0.2-0.3	0.06	0.3	0.2-0.3
Gross consumption (5)	4.73	4.2	3.4-3.7	8.29	6.7	5.5-5.8
Oil export (6)	4.33	3.4	3.2-3.5	2.07	2.1	2.1-2.4
Crude Oil	3.26	2.5	2.2-2.5	1.21	1.5	1.5-1.8
Oil products	1.06	0.9	0.9-1.1	0.86	0.6	0.5-0.7

(1) updated, (2) approx. estimation, (3) forecasts, (4) used to meet the country's own needs, including direct consumption and losses, (5) including the country's proper consumption of oil, the increase of oil processing volumes, processing, distribution and transport losses, consumption of petrochemical raw materials, changes in stocks, (6) with no regard to reexport. For Russia the volume of trade with other republics of the former USSR is included.

The implementation of the Fuel and energy federal programme ensures the following levels of processing and producing, millions of tons per year

	Years	
	1992	1998
Processing of petroleum	251.1	250-260
Depth of processing, %	64.0	72-75
Production of Motor Fuels	113.9	126-130

including		
Jet Fuels	13.7	15-16
Petrol	35.0	38-42
Diesel	65.2	70-75
Production:		
Lubricants	4.04	5.2-5.5
Asphaltic Oil	5.31	9.9-10.8
Bunker Oil	88.0	68-72
Motor Fuels including:		
Unleaded Petrol, %	30.2	65-70
Diesel Fuels with		
Sulphur Contents till 0.02, %	65.0	0-75

Nearly all of the energy consumed today i.e. 17 billion tons of conventional fuel annually, including 2.5 billion tons of conventional fuel in Russia minus 0,4 billion tons the exported conventional fuel is produced by burning of organic fuel.

Half of the energy currently produced in Russia accounts for electricity and heat including:

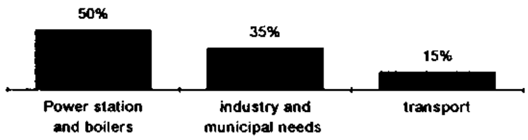


Figure 2. Casting of Energy

Thus, the share for transport goes to approximately 1/7.

- **Actual Situation Regarding Traffic Emissions**

- **Existing Infrastructure (railways, roads and ports)**

As a result of a continuing fall of the industrial production in Russia at present, ecological loads on the environment have lowered. At the same time traffic emissions remain on a high level partly due to the fact that the specific emissions figures have not improved.

There exist more than 1059 cities, 2066 urban type settlements and 155,000 small settlements in the territory of Russia where live about 73 percent of the entire country's population. One in every ten cities of Russia has a high level of the environmental pollution. Practically all cities having population more than one million inhabitants like St.-Petersburg or Moscow should be prefered to as having "the highest" or "very high" unfavorable ecological situation level. Cities between 500,000 and 1,000,000 inhabitants account for about 60 percent, while cities between 250,000 and 500,000 inhabitants account for only 25 percent.

Big cities, these old centres of agglomeration, have preserved historically a mixture of functional zones, such as industrial, municipal, residential, recreational etc. areas where the absence of the necessary protective zones contribute to a high level of pollution bringing the share of traffic emissions to 40-50 percent. These levels for Moscow exceed 80 percent.

Highly intensive road traffic in the big cities of 1,000 to 3,000 vehicles/h along with the inperfectional road network and a high traffic congestion especially in the central parts contribute to an excessive level of pollutants such as Nitrogen Oxides, B(a)P, Carbon Oxide.

With an ever growing number of cars, trucks and buses on the roads, all cities over the world are having more and more to face the problems of traffic congestion and air pollution. The improvements in the infrastructure, optimization of traffic and due financing on the federal and local levels will help to solve these problems.

Annual Pollutant Emissions in Russia by Type of Transport, , thousands of tons [5]

	CO	HC	NOx	SO_2	Partcl.	Lead
Cars	18.73	3.64	2.74	0.11	-	0.02
Buses	22.68	1.76	1.81	0.16	0.09	0.01
Light Duty Trucks <3,5t	21.24	2.60	2.78	-	-	0.011
Heavy Duty Vehicles >3,5t	24.95	3.89	8.34	1.80	0.66	0.016
Motor Vehicles	87.60	15.67	11.89	2.07	0.75	0.57
Passenger Trains	0.25	0.06	0.058	0.03	0,006	-
Freight Trains	1.72	0.51	5.83	0.22	0.055	-
Water Transport	0.26	0.18	0.69	0.24	0.10	-
Marine Transport	0.19	0.14	0.49	0.51	0.56	-
Air Transport	1.49	0.94	0.55	0.23	0.058	-
Total	91.51	13.72	23.81	3.30	1.03	0.057
Gross Pollution	data not available				2.18	0.070

Percentage Volumes of Emissions by Tape of Transport

	percent
Motor Vehicles, including	95.7
Cars	20.47
Light Duty Trucks	23.2
Heavy Duty Vehicles and Inter urban Buses	52.3
Railways Transport	2.15
Ships	0.49
Jets	1.62

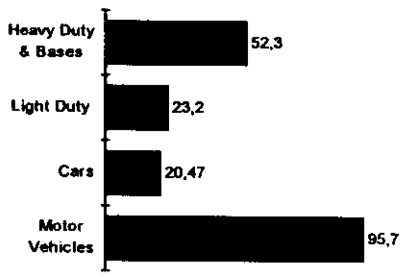


Figure 3. Percentage Volumes of Emissions by Tape of Vehicles

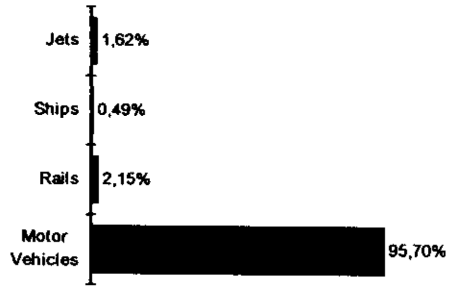


Figure 4. Percentage Volumes of Emissions by Tape of Transport

Consumption of Motor Fuels, Russia, thousands of tons

Leaded gasolene	39.67
Unleaded gasolene	10.54
Diesel Fuel	2.8
Gas (condensed petroleum gas / compressed natural gas)	0.1
Others	-
Total	53.12

Thous.of Tons

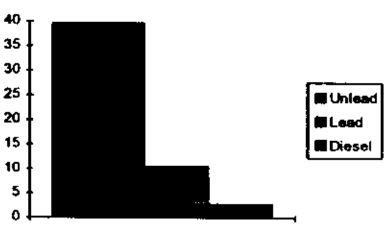


Figure 5. Consumption of Fuels

The Leningrad Region

Total transport of freights by all types of transport in 1990 accounts for 441.5 million tons.

The Novgorod Region

The freight and passenger traffic in 1990 by type of transport:

Freight (millions of tons)

Motor Vehicles	35.9
Ships	5.5

Passenger (millions of passenger-km)

Motor Vehicles	87.4
Ships 5.0	

The Kaliningrad Region

The Volume of Traffic in 1990, millions of tons

Motor Vehicles	13.5
Rails	10.0
Sea Transport	3.6
River Transport	5.8

The Republic of Karelya

The volume of traffic in 1990 accounts for 114.9 million passengers.

The Volume of Traffic, millions of tons

Motor Vehicles	15.0
Rails	25.4
Ships	12.9

The river navigation in the Baltic region is mainly concentrated on the Neva, Volkhov and Sheksna rivers and the Ladojskoye· and Onejskoye Lakes, as well as on the systems of channels. Besides a river-sea navigation of a mixed type also takes place in that region.

The Length of Water-ways, km:

St.-Petersburg Region	1500
The Republic of Karelya	720
Kaliningrad Region	365
Novgorod Region	325

The total number of river-sea vessels in Russia in 1990 amounted to 15378 units. Depending on the service life of these vessels the figures below represent their percentage share in the total number:

To 2 years	2.8
2-10	23.2
11-20	33.5
21-30	25.2
31-40	9.6
41-50	0.4
more than 50	0.3

The average vessel age is 17.1 years

Motor fuels produced by oil processing in Russia give 86 percent of energy for transport needs.

Production of Energy and Fuels by Kind

Production		Consumption	
Motor Fuel	86%	Internal combustion engines,	
Diesel	115 billion tons	including engaged in agriculture	58%

Petrol	65 billion tons of conventional fuel		
Jet Fuel	33 billion tons of conventional fuel	Railways	21%
Bunker Oil	3%	Aircraft	13.5%
Electric Power	10.8%	Vessels	7.5%
Condensed Gas	0.2 %		

St.-Petersburg, the St.-Petersburg Region and the Novgorod Region

Transport Productivity

Type of vessel	Number of vessels	Total power, h.p.	Productivity in thous.of tons-km
Passenger's	96	81800	262.9
Freight's	243	348000	14340
Tugboated	67	45900	1036
Auxiliary	113	29000	-
Total	519	504800	15640

The Republic of Karelya

Transport Productivity

Type of vessel	Number of vessels	Total power, h.p.	Productivity in thous.of tons-km
Passenger's	16	25250	38
Freight's	153	231970	10920
Tugboated	18	15180	260
Auxiliary	25	7050	-
Total	212	279450	11220

The Kaliningrad Region

Transport Productivity

Type of vessel	Number of vessels	Total power, h.p.	Productivity in thous.of tons-km
Passenger's	2	1900	0,3
Freight's	36	34210	1680
Tugboated	18	4950	84.5
Auxiliary	14	2700	-
Total	70	43760	1765

The Diesel fuel consumption by type of transport give the following figures in the Kaliningrad region taken as an example:

	Percent	
	Freight	**Passenger**
Rails	6.3	15.8
Ships	65.3	10.5
Road	20.3	73.6
Others	8.5	-
Total	93.4	6.5

The degree of pollutant emissions to the atmosphere by various types of transports may be illustrated by the following figures for the Kaliningrad region taken as an example:

Annually Traffic Emissions in the Kaliningrad Region, thousands of tons

Emissions Species	Types of Transport: Motor Vehicles	Rails	Ships	Jet	Total
Carbon Monoxide (CO)	58,66	1,116	5,368	0,950	66,094
Hydrocarbon (HC)	8,268	0,300	2,455	0,570	11,593
Nitrogen Oxides (NOx)	5,262	1,199	10,288	0,650	17,399
Particles (C)	0,689	0,100	0,890	0,040	1,719
Sulphur Dioxide (SO_2)	0,563	0,120	0,822	0,090	1,595
Lead (Pb)	0,015	-	-	-	0,015

The average contents of pollutant substances in the exhaust gases of automobiles (without N_2, O_2, H_20):

Harmful components	Diesel mass percent	Diesel toxic(CO)	Petrol mass percent	Petrol toxic(CO)
Carbon Dioxide (CO_2)	98,61	0, 2 9	6,6	5,8
Carbon Monoxide (CO)	0, 4	9,6	2,6	38,7
Hydrocarbon (HC)	0, 2	0, 1	0, 4	0, 1
Nitrogen Oxides (NOx)	0, 4	21,1	0, 3	12,1
Sulphur Dioxide (SO_2)	0, 3	42,2	0, 02	1,7
Particles	0, 1	16, 0	0, 008	0, 2
Aldegids (RCHO)	0, 005	0, 8	0, 002	0, 2
Lead	-	-	0, 003	41,2

The Structure of Pollutant Components of the Diesel Exhaust Gases

Harmful Components	Concentration g/м^3	Specific division, g/kw/h
Carbon Monoxide (CO)	0.25-2.5	1.5-12.0
Sulphur Dioxide (SO_2)	0.1- 0.7	0.4-2.5
Acrolein	0.01-0.04	0.06-0.2
Hydrocarbon (HC)	0.25-2.0	1.5-8.0
Polyciclic Aromatic Hydrocarbon	$0.2*10^{-6}$ - $0.5*10^{-6}$	$1*10^{-6}$ - $2*10^{-6}$
Nitrogen Oxides (NOx) including:	2-8	10-30
Nitrogen Dioxides (NO_2)	0.1-0.8	0.5-2.0
Nitrogen Oxide (NO)	1.2-4.5	6-18
Particles	0.05-0.5	0.25-2.0

Traffic Emissions, kilo grammes per ton of fuel

Harmful Components	Type of Motor Petrol	Diesel
Carbon Monoxide (CO)	395	9
Hydrocarbon (HC)	34	20
Nitrogen Oxides (NO, NO_2, N_2O_4, N_2O_5)	20	33
Organic Acid	1.4	6.0
Sulphur Oxides (SO_2, SO_3)	1.55	6.0
Particles	2.0	16.0

Traffic Emissions, percent

	Cars		Light Duty		Heavy Duty and Buses	
	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel
Carbon Monoxide (CO)	81,9	2,4	4,0	1,2		10,5
Hydrocarbon (HC)	74,1	4,6	2,7	4,3		14,3
Nitrogen Oxides (NOx)	44,6	12,2	1,3	4,9		37,0
Sulphur Dioxide (SOx)	-	30	-		10	60
Particles (C)	-	30	-		10	60

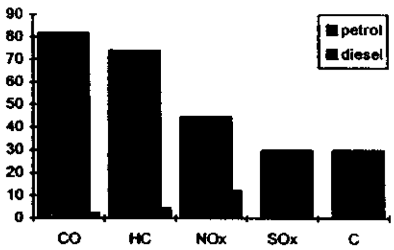


Figure 6. Traffic Emissions, percent

Essentially, the pollution estimates are made on the basis of the milage run. The tendency to decreasing the pollutions can be explained by a reduction in the milage run.

- **Traffic Development in the Past**

The dynamics of the country's transport development can be illustrated to a degree by the motor vehicle fuel consumption.

Fuel Consumption by Type in Russia, thousands of tons

	Years 1980	1990	1991	1992	1993
Leaded gasolene	9.15	29.98	36.36	35.55	39.67
Unleaded gasolene	1.61	7.49	9.66	9.45	10.54
Diesel Fuel	0.12	0.43	0.49	2.00	2.81
Gas (condensed petroleum gas or compressed natural gas)	-	0.07	0.10	0.11	0.10
Others	-	-	-	-	-
Total	10.88	37.97	46.61	47.92	53.12

Thous. of Tons

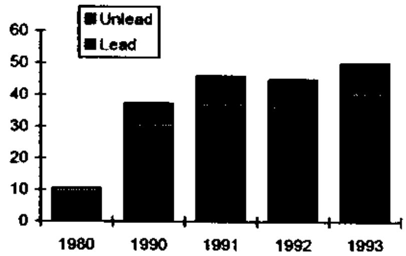


Figure 7. Unleaded/Leaded Gasolene Consumption

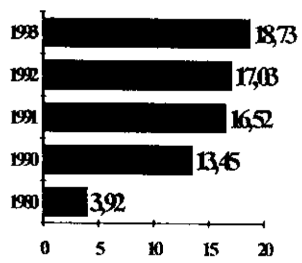
In the absence of the proper emission controls ecologically unsafe vehicles, continue to operate, residential zones and places for rest and recreation are often used as parking places worsening the ecological situation, damaging grounds, polluting underground waters and natural landscapes.

Pollution dynamics by vehicle type in Russia

Carbon Monoxide (CO) Emissions, thousands of tons

	Years				
	1980	1990	1991	1992	1993
Cars	3.92	13.45	16.52	17.03	18.73
Buses	22.44	9.02	27.80	24.39	22.68
Light Duty Trucks < 3,5t	11.38	20.23	24.28	25.29	21.24
Heavy Duty Vehicles > 3,5t	31.48	39.50	39.20	29.70	24.95
Motor Vehicles	69.22	102.2	107.80	96.41	87.6
Passenger Trains	0.58	0.30	0.27	0.27	0.25
Freight Trains	2.06	1.96	1.78	1.75	1.72
Water Transport	0.46	0.46	0.43	0.33	0.26
Marine Transport	0.21	0.30	0.23	0.21	0.19
Air Transport	0.93	1.77	1.96	1.69	1.49
Total	73.46	107.	112.5	100.7	91.5
Gross Pollution	240.46	19282	18844	data not available	

Thous.of Tons



Cars

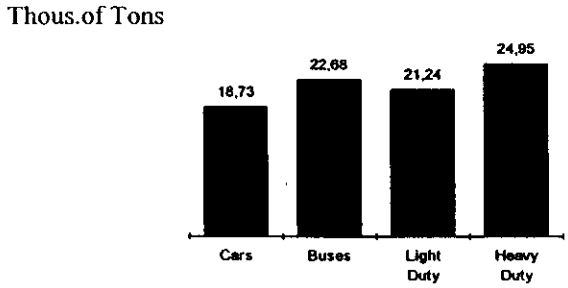


Figure 8. Annual CO Emissions

Nitrogen Oxides (NOx) Emissions, thousands of tons

	Years				
	1980	1990	1991	1992	1993
Cars	0.57	1.97	2.42	2.49	2.74
Buses	1.79	2.32	2.22	1.95	1.81
Light Duty Trucks < 3,5t	1.49	2.65	3.18	3.31	2.78
Heavy Duty Vehicles > 3,5t	10.53	13.20	13.10	9.93	8.34
Motor Vehicles	14.38	20.14	20.92	17.68	15.67
Passenger Trains	1.33	0.68	0.62	0.62	0.58
Freight Trains	7.02	6.66	6.07	5.95	5.83
Water Transport	1.22	1.22	1.16	0.88	0.69
Marine Transport	0.53	0.74	0.60	0.54	0.49
Air Transport	0.35	0.66	0.73	0.63	0.55
Total	24.89	30.10	30.10	26.30	23.81
Gross Pollution	65.26	60.80	60.65	data not available	

Hydrocarbon (HC) Emissions, thousands of tons

	Years				
	1980	1990	1991	1992	1993
Cars	0.76	2.61	3.21	3.31	3.64
Buses	1.74	2.25	2.15	1.89	1.76
Light Duty Trucks < 3,5t	1.39	2.47	2.97	3.09	2.60
Heavy Duty Vehicles > 3,5t	4.91	6.16	6.11	4.63	3.89
Motor Vehicles	8.80	13.49	14.44	12.92	11.89
Passenger Trains	0.13	0.066	0.06	0.06	0.06
Freight Trains	0.61	0.584	0.53	0.52	0.51
Water Transport	0.32	0.32	0.31	0.23	0.18
Marine Transport	0.15	0.21	0.17	0.15	0.14
Air Transport	0.59	1.12	1.24	1.07	0.94
Total	10.60	15.79	16.75	14.95	13.72
Gross Pollution	96.00	71.17	68.83	data not available	

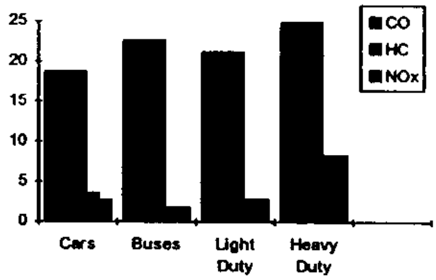


Figure 9. Pollutant Emissions by Vehicles, thousands of tons

Sulphur Dioxide (SO_2) Emissions, thousands of tons

	Years				
	1980	1990	1991	1992	1993
Cars	0.24	0.79	0.97	0.10	0.11
Buses	0.156	0.20	0.194	0.17	0.16
Light Duty Truck < 3,5t	-	-	-	-	-
Heavy Duty Vehicles > 3,5t	2.28	2.86	2.84	2.15	1.80
Motor Vehicles	2.46	3.14	3.13	2.42	2.07
Passenger Trains	0.065	0.03	0.03	0.03	0.03
Freight Trains	0.27	0.26	0.23	0.23	0.22
Water transport	0.27	0.31	0.30	0.27	0.24
Marine transport	0.55	0.77	0.63	0.56	0.51
Air transport	0.145	0.27	0.30	0.26	0.23
Total	3.76	4.78	4.62	3.77	3.30
Gross pollution	20.476	10.664	96.27	data not available	

Particles and Lead, tons

	Years									
	1980		1990		1991		1992		1993	
	Part	Pb	Part	Pb	Part	Pb	Part	Pb	Part	Pb
Cars	-	0.5	-	2.3	-	1.6	-	2.1	-	2
Buses	7.4	0.8	7	0.8	9.5	1.1	8	0.9	9	1
Light Duty Truck	-	0.6	-	1.0	-	1	-	1.2	-	1.1
Heavy Duty Vehicles	5,3	1.3	42	1.0	66	1.6	50	1.2	66	1.6
Motor vehicles	60.4	3.2	49	5.1	76	5.3	58	5.4	75	5.7

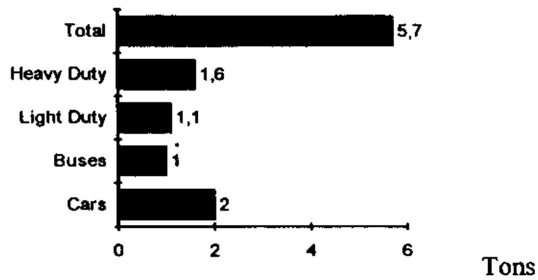


Figure 10. Lead Emissions of Motor Vehicles

Passenger Trains	1.4	-	0.6	-	0.7	-	0.6	-	0.6	-
Freight Trains	6.4	-	5.3	-	6	-	5.4	-	5.5	-
Water Transport	11	-	6	-	11	-	8	-	10	-
Marine Transport	5	-	4.6	-	6.9	-	5	-	5.6	-
Air Transport	2.8	-	4.4	-	5.2	-	5	-	5.8	-
Total	89	3.2	70	5.1	106	5.3	82	5.4	103	5.7
Gross Pollution			data not available						218	7.0

Traffic Emissions in St.-Petersburg, thousands of tons

	1990	1991	1992
Stationary Sources	191.5	180.6	150.9
Motor Vehicles	244.5	226.6	169.8
Total, including:	436.0	407.0	320.7
Carbon Monoxide	224.1	202.2	150.6
Hydrocarbon	38.2	36.1	25.7
Particles	34.6	27.2	21.8
Nitrogen Dioxide	57.5	54.1	47.9
Sulphur Dioxide	62.7	70.1	61.2

- **Traffic Emissions in Comparison .with the Industrial Emissions**

Transport remains a significant source of air pollution. A contribution of the vehicle emissions to the total air pollution in Russia at present by estimates goes to 12,97 million tons making 70.42 percent of CO, 17.23 percent of NOx, 10.15 percent of HC and 2.2 percent of SO_2 showing a decrease of 1.37 percent against the 1993 figures.

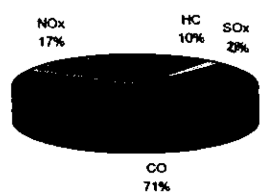


Figure 11. Percentage Distribution of Pollutants

The total emissions from mobile sources in 1994 in Russia according to the approximate estimates give the following figures:

Traffic Emissions, Russia , thousands of tons

	Years		
	1992	1993	1994*
Transport on the Whole			
Carbon Monoxide	10079	9138	9138
Nitrogen Oxides	2855	2395	2237
Hydrocarbon	1422	1304	1316
Sulphur Dioxide	370	318	284
Gross Pollutions	14726	13155	12975
Motor Vehicles			
Carbon Monoxide	9641	8760	8200
Nitrogen Oxides	1768	1567	1460
Hydrocarbon	1292	1189	1365
Sulphur Dioxide	242	207	187
Gross Pollutions	12943	11723	11212

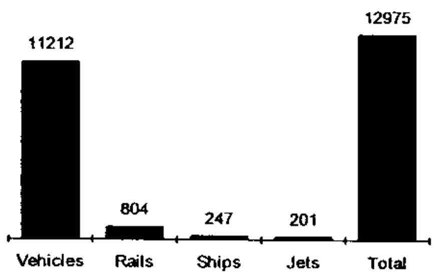


Figure 12. Traffic Emissions, thousands of tons

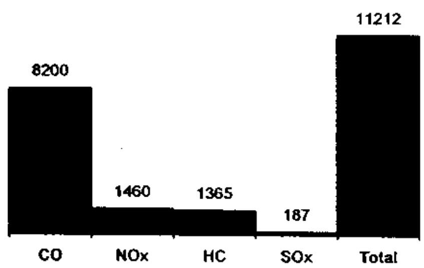


Figure 13. Percentage Distribution of Pollutants, thousands of tons

Railways Transport

	1992	1993	1994*
Carbon monoxide	202	197	193
Nitrogen oxides	657	641	530
Hydrocarbon	58	57	56
Sulphur dioxide	26	25	25
Gross pollutions	943	920	804

Water Transport

Carbon Monoxide	33	28	22
Nitrogen Oxides	88	76	74
Hydrocarbon	23	20	23
Sulphur Dioxide	27	23	19
Gross Pollutions	171	147	138

Marine Transport

Carbon Monoxide	21	18	16
Nitrogen Oxides	54	47	39
Hydrocarbon	15	13	12
Sulphur Dioxide	56	49	42
Gross Pollutions	146	127	109

Air Transport

Carbon Monoxide	182	135	125
Nitrogen Oxides	86	64	45
Hydrocarbon	34	25	20
Sulphur Dioxide	19	14	11
Gross Pollutions	321	238	201

* approximate estimates for 1994

Transport pollutions to the atmospheric air remain one of the major factors of the impact on the environment.

Annual Pollutant Emissions from Motor Vehicles (M) and from Industry (Mi), thousands of tons and their Contributions to Total Pollution M /(M + Mi) in Russia

	Total	CO	NOx	HC
M, thousands of tons	17296.7	13462.8	1273.0	2560.9
Mi, thousands of tons	15819.4	7587.5	3029.7	5202.9
M + Mi, thousands of tons	33116.1	21050.3	4302.7	7763.1
M /(M + Mi), percent	52	64	30	33

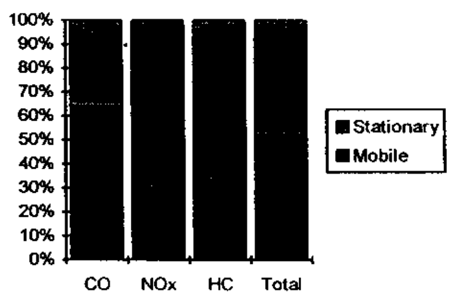


Figure 14. Traffic Emissions vs Industrial Emissions

Motor vehicle emissions in M in the regions having an impact on the pollutions in the Baltic Sea area), and their contributions to the total air pollutions in M /(M+ Mi) by estimates made:

Regions	M	Total (M /(M +Mi)	Including CO	NOx	HC		
	Thous.of Tons per Year	Percent	Thous.of Tons per Year				
St.-Petersburg		226.6		56	178.5	14.8	33.8
Kirov Region	157.8	38	125.6	8.9	23.3		
Murmansk Region	140.6	17	104.7	14.4	21.5		
St.-Petersburg Region	141.0	21	111.4	8.3	21.3		
Arhangelsk Region	101.1	13	80.4	5.0	15.6		
Kaliningrad Region	82.8	48	67.0	4.5	11.3		
The Republic of Karelya	77.1	20	61.5	4.6	11.0		

The regions of St.-Petersburg, Kirov Region, Kaliningrad Region and the Republic of Karelya make a significant influence on the total air pollutions in the area.

- **Existing Vehicle Emission Regulations**

The realization of the long-term steady development strategy demands better use of the existing technologies, their perfection, more effective use of the existing transport capacities, a shift to use ecologically safer types of transport and a reduction of currently operating transport units.

Main objectives of these strategy also envisage the development and introducing of emission standards, fuel and emission controls, better plaining of transport development as well as the rise in the volumes of freights and passengers carried by railways and marine transport.

The implementation of the modern exhaust emission standards and quality surveillance on fuels demand more stringent requirements for use of petrol and Diesel fuels, partial reconstruction of oil refining plants and taking special measures regarding the stimulation of such work.

It is suggested that pursuant to the programmes accepted by european countries leaded gasolene should be taken away from use by the west-european countries at the present time and by east-european countries by the year 2,000.

A transition to lead-free gasolene demands the introduction of integrated taxation, fixation of lower prices on lead-free gasolene in comparison with leaded gasolene and use of antydetonate adding having no lead component. However a small number of old model vehicles needed leaded gasolene will continue to operate on such kind of fuel.

The level of sulphur contents in Diesel fuels according to the west-european standards should be limited to 0,005 percent by 1995. For the east-european countries the level of sulphur contents in Diesel fuels should be limited to 0,3 percent by 1995 and 0,005 percent by 2000. Such measures will allowed to introduce the improved Diesel technologies

The most effective way of reducing of all kinds of exhaust emissions remains the improvement of fuel efficiency and reduction of fuel consumption, modernization of the automobile engines and components and production technologies, which will make it possible to cut the existing fuel consumption rates by 20 percent

Others measures intended to low vehicle pollutant for example the reduction of the engine working volumes along with the establishment of more stringent traffic speed limits will give further a 50 percent fuel consumption cut.

The application of the European standards -83 relating to new vehicle models of automobiles is scheduled as a first step, with their distribution subsequently on the vehicle types currently in use. One of the serious obstacles to the introduction of these standards is the use of lead additives to motor fuels preventing from the application of catalysts.

Last time it has been proposed to economically stimulate the production of lead-free gasolenes and low sulphur fuels. The application of the more rigid international standards will depend fully on the problem of the lead-free gasolene supply.

A switch to the exceptional production of lead-free gasolenes, as well as unleaded additives intended to increase fuel efficiency require additional investments, which presents a number of problems taking into account the existing economical situation in Russia and they are not likely to be solved within a short time frame.

Also, a considerable reduction of exhaust emissions can be achieved through the more wide application of diesel and gas fuels, which as it is supposed will bring the contents of carbon monoxide in the diesel exhaust gases by 10 to 15 times lower and cancerogenic substances contents by 20 to 30 times less than in the exhaust gases of petrol-operated vehicles.

One of the restraining factors of the wide use of gas-fueled vehicles is the lack of economic interest at present on the part of car manufacturers and vehicle operating enterprises for the reason of high prices on gas fuels and gas equipment as well as poor design and quality of the gas instruments in current use.

The ecological problems are largely connected with the volumes of automobile traffic. Fixing low prices on transport services at the expense of low fuel prices and expanding road networks are considered as a precondition to the country's economic growth.

The experience of the major European countries relies on the improvement of the system of urban planning, consisting, in particular, in avoiding hard traffic loads in the urban centres by managing obstacle-free traffic and vehicle parking. The establishment of prices for the use of urban roads and parking places is likely to limit the frequent use of private automobiles and, which is more important, to switch transport loads on public transport. These measures act as an important tool in the transport policy on the whole.

Russia joined the 1958 Geneva Agreement and accepted the practice of application of international standards particularly those relating to a direct application of UN ECE Regulation 24 (smoke of Diesel) and 49 (toxic of Diesel) and the opportunity of application of Regulation 83 (01 and 02 series) is now being considered.

The country's domestic industry is able to use modern technologies including the three-way catalyst technology and ignition electronic equipment. The necessary hardware meeting the requirements established by these standards is being prepared now for production.

Concerning the requirements specified in UN ECE Regulation 49, 02 series of amendments, type B, and EC-Directive 91/542/EEC, type B, the necessary hardware to meet the requirements established by these standards is also under production. To improve the ecological qualities of Diesel engines the KaMAZ, YMZ and ZIL production plants have started the production of fuel instruments with a high pressure of injection and turbo chargers of a high efficiency.

According to the Fuel and energy federal programme it is supposed that by 1998 the production of unleaded gasolene is to be increased by 65-75 percent whereas these figures in the year 1992 stood for 35 percent.

- **Future Development**

The Volumes of Production and Consumption of Main Petroleum in Russia in the Future

	fact.	1993		1995		2000	
	1990	optm	pesm	optm	pesm	optm	pesm
Production							
Oil	233.8	216.1	184.3	215.2	182.7	211.0	168.1
Motor Fuels	117.2	106.9	91.7	111.7	95.5	124.3	101.3
Jet Fuels	16.3	15.2	13.2	15.9	14.0	17.1	14.4
Black Oil	100.3	94.0	79.4	87.6	73.2	69.6	52.4
Consumption							
Oil	173.7	170.6	165.3	166.5	160.4	155.5	149.3
Motor Fuels	84.2	79.9	77.3	79.5	74.4	84.1	79.8
Jet Fuel	10.9	15.2	13.2	15.9	15.9	17.1	17.1
Black Oil	78.6	75.5	74.8	71.2	70.1	54.3	52.4

If current trends continue domestic production of crude oil is expected to fall the next year by 11 percent down the 1993 figure.

- **Traffic Forecasts**

In spite of the fact that the volume of automobile traffic in the east European countries including Russia on the whole is considerably lower, than in the west European countries, vehicle emissions in Russia average 40-45 percent of the total air pollution level, which is connected in particular with a significant share of freight transport in the traffic system, poor quality of fuels, road and motor vehicles. Owing to the fast growing automobile fleet the situation might become still worse in the near future.

It seems obvious, that the continuing growth of the automobile fleet and other kinds of transport will result in the end in still more serious ecological loads on the environment.

The following figures show the average traffic distribution of imported/domestic cars and city buses in Russia. It should be noted that a significant share of the city transport makes city buses and the portion of imported city buses rises.

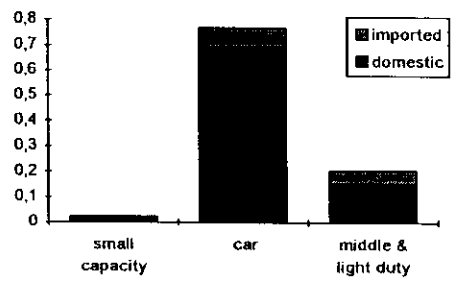


Figure 15. Imported/domestic cars in traffic

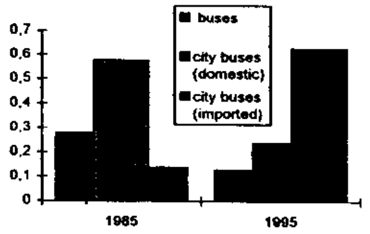


Figure 16. Imported/domestic city buses in traffic distribution

A reduction of NOx emissions to the european standards is expected to bring the level of such emissions from heavy trucks to 50-60 percent of the total NOx emissions from all trucks and a considerable decrease in the passenger car emissions which will be reached by that time is supposed to contribute significantly to a reduction of the mobile sources overall pollutions.

- **Infrastructures**

The transport infrastructure responds to the country's economic level, the availability of fuel and power resources, their production and the efficiency of their use.

In this connection the transport policy should be directed to maintaining economic communications, transportation needs, competitiveness of domestic automobile manufactures, and the quality of the environment following the concept "of steady development" and obligations pursuant to the international agreements.

All that requires the application of a system approach defining proper ways of the transport system development as a whole answering the national fuel and power programme, economic development, efficient use of resources and the national legislation.

The achievement of these purposes is linked in the first place with the necessity of the decreasing pollutant emissions in the source, processing and cleaning of petroleum and increasing lead-free gasolenes production as well as fuel efficiency, implementing catalyst systems, lowering fuel losses. An important aspect of the achievement of these proposes is the use of alternate kinds of fuel including the replacement of motor gasolenes by natural gas, having in view the achievement of the level of the european standards and the introduction of the certification and licensing of transport means meeting the international standards.

The decision of these tasks depends to an even greater degree on the improvement of the infrastructure of the transport system, construction of the network of transport mains, transport flow managing, appropriate financing on the federal and regional level and an effective economic stimulation.

- **Law / Regulations Relating to Transport and Environment**

The Law of protection of the environment adopted in 1991 introduces a system of the environmental regulation and specifications for air quality and ecological safety. A number of administrative acts of a direct action are being developed as a result of the adoption of this federal Low with regard to the atmosphere, ecological safety, petroleum and natural gas, alternative fuels, protection of the population from harmful affects of petroleum regulating on a stage by stage level the decrease of traffic emissions and the restriction of sulphur contents in diesel fuels in order to stabilize the ecological condition and to observe the national and international standards on the environment protection.

The ecological stabilization of the existing transport system is supposed to achieve on the basis of the perfection of the system of federal and municipal ecological regulations on transport pollutant emissions and a system of administrative and economical sanctions and privileges as well as the establishment of the ecological control and certification.

The Law of protection of the environment introduces the economic stimulus of protection of the environment, by fixing rates for the use of natural resources and the environment pollution.

All technical elements of the transport system, connected with the potential danger of pollution of the environment such as vehicles, fuels and oils, equipment, technologies, road networks should be certificated in conformity with the existing ecological requirements;

Russia recognizes the necessity of a perfection of the national ecological regulations of the transport system. In 1990 a decision about a direct application of EC Rules was taken. Temporary schedule of introduction of these standards should be adopted not later than by the year 2000.

But, in practice the ecological characteristics of the automobiles manufactured in Russia do not meet the European norms. Besides, the vehicle manufacturers do not give proper warranties on the stability of ecological characteristics for their products

The application of the European norms is assumed in the first place for new models of automobiles, with their subsequent distributions on the vehicles in a current use.

In the field of legal regulations the following steps have been undertaken directed to a restriction in the use of leaded gasolene. The lead content in the fuels currently produced in Russia grades to 0.15-0.37 g/l. After the 1st January 2000 lead content will grade to 0.1 g/l and benzene contents should not exceed 5 per cent.

A prohibition of the use of gasolene with lead contents exceeding 0.01 g/l and benzene contents exceeding 5 per cent is now effective in the Moscow, St. -Petersburg, Kaliningrad regions and a number of others.

- **Measures e.g.**

For the past two decades a considerable progress in the decrease of fuel consumption of new automobiles has been achieved in the world. Today the fuel consumption characteristics of new automobiles nearly twice as high as those in the early 70's.

On the average fuel consumption of vehicles has decreased with 16,6 litres on 100 km in 1973 to 8,3 litres on 100 kms in 1987. Since 1970 in OBESE countries an average fuel consumption per automobile has decreased by nearly 25 percent. The efficiency rate is achieved essentially through a significant reduction of the weight of automobiles, application of such substitutes of steel, as aluminium, plastics and ceramics, as well as the improvements introduced in motors and transmission systems.

The structure of the automobile fleet by the type of fuel used renders a considerable influence on the environment. At existing structure the share of automobiles using petrol, makes about 70 percent, though the international experience shows, that the use of petrol motors the most effectively by automobiles of small capacity, and on other - Diesel ones.

One of the efficient ways to improve the still worsening ecological situation is to restructure the fleet of automobiles in a current use, for example, by bringing those operating on petrol to 25 percent, on diesel fuels to 40 percent and on gas to 35 percent. In these way pollutant emissions from automobiles may be decreased by 25-30 percent with other conditions being equal.

The NOx Emissions of heavy duty Diesel vehicles manufactured in Russia exceed 12-16 grammes/kw-h which 1.5-2 times more than the standard level. The emissions of firm particles also exceed the level of standards giving a figure of 0.6-2.0 gramme/kw-h. CO and HC emissions nearly meet the level of' requirements. But a decrease of NOx emissions to the level of will make the rate of CO and HC emissions higher. This is a common problem all the manufacturers are facing with.

The introduction of more stringent requirements for smoke and the toxcicity of diesel exhaust gases will involve deeper processing and clearing of petroleum and the use of secondary products in the structure of diesel fuels, necessitating in turn an increase of the contents of aromatic hydrocarbons in fuels and additional controls

The comparison of data on the sulphur contents in diesel fuels, made in Western Europe and the USA, shows, that the least quantity of sulphur in fuels, used in the Scandinavian countries makes 0.06-0.1 percent. The sulphur contents in diesel fuels, used in the central european countries make 0,08-0,28 percent. The sulphur contents in diesel fuels produced in Italy, Portugal and Greece have appreciably decreased with 0,5-1,0 percent in 1985 to 0,3 percent in 1990. Russia produces 48 percent of diesel fuels with sulphur containing up to 0,2 percent and about 51 percent of diesel fuels containing 0,5 percent of sulphur thus putting the consumers in a condition more dependent from the quality of fuels and making the problem of decreasing of pollutant emission from motor vehicles more complex. An essential decrease of sulphur contents in diesel fuels up to 0,1-0,05 percent demands special technologies and is planned to make on a stage by stage way, at first bringing it to 0,1 percent with a subsequent reduction to 0,05 percent.

A reduction of the contents of aromatic hydrocarbons and sulphur in diesel fuels requires significant investments, which is linked primerily with the application of expensive catalysts.

It is also planed to cut the contents of aromatic hydrocarbons in fuels from 24 percent to 10 percent as required by the european specifications for fuels that will allow to decrease the specific emissions of firm particles with 0,7 g/ kwt-h to 0,5 g/kw-h.

Urgent remains the problem of the application of antydetonate additives to fuels, enabling to low smoke in exhausted gases to 40-50 percent, at the same time resulting in some (approximately by 10 percent) rise in the fuel price.

The qualitative and quantitative purposes of the programme of actions on the reduction of vehicle emissions are oriented on:

- perfection of processes in internal combustion engines;
- application of catalysts systems, including 3-way catalysts, electronic control block, gauges of oxygen etc.

- application of fuel injections and microprocessor control systems;
- application of the recirculation systems of exhaust gases;
- application of the filter-catalyst for Diesel engines for clearing of firm particles, carbon, carbon oxides, hydrocarbons and nitrogen oxides;
- application of the vapor restricting system for collecting fuel vapors from carburetor and fuel tanks;
- use of lean mixtures in the infernal combustion engines
- use of two-fuel power supply systems (gas - liquid fuel);
- use of turbo pressurization with the intermediate cooling of air.

- **Catalyst Programme**

The most effective way of emission reduction is the application of catalysts requiring the use of lead-free gasolenes making at present only about 30 percent from the total volume of all gasolenes produced.

The main obstacle for introduction in Russia of pure motors and vehicles is an excessive availability in the market of leaded gasolene, as well as production of diesel fuel with high contents of sulphur. In this connection it is necessary in the first place to supply high-octane unleaded gasolene and its trouble-free delivery to all regions.

One of the practical ways of introducing catalysts is a mixed supply of gasolenes suggesting a separate fuel storage in the refueling stations and a reliable lead content control on fuels.

Catalysts applied for diesel powered heavy duty vehicles and interregional buses allow to low emissions of CO and HC by 80 percent and firm particles by 20 percent. The carbon filters are expected to low significantly emissions of firm particles and aromatic hydrocarbons. New types of catalysts enabling to reduce NOx emissions from heavy duty vehicles should be developed and installed on the older types of transport in a current use. Sufficient industrial base on manufacturing catalysts is present.

The implementation of the best available technologies for vehicles and fuels in all transport modes in Russia is now being studied.

- **Plans for Transport Systems Taking Into Account Environment Aspects**

In the framework of the mentioned tasks it is planed to:

- develop automated systems of air pollution controls on the road networks in the cities;
- develop measures, promoting the achievement of the European vehicle emission standards;
- specify the level of railways transport impact on the environment and to develop a system of measures decreasing its effect on the ecology system;
- develop methods of estimation of the river and marine transports impact on ecology system;

The shortage of the federal and regional financial and technical means in creating the necessary transport links as well as engineering problems is now being studied

A considerable decrease of the contents of toxic pollutant emissions can be achieved through wider use of diesel and gas engines. Furthermore, a combination of gasolene and natural gas considerably improves the characteristics of automobile running on natural gas 2-2,5 times reducing the losses of engine power.

In the gasolines with improved ecological properties (AI-80, AI-95 gasolenes) and improved specifications (AI-76, AI-92 gasolenes) now produced in Russia the contents of benzene do not exceed 5 per cent by volume and the contents of sulphur are equal or below 0,05 percent. Now under production are also gasolene (AI-93 and AI-95 gasolenes) with the contents of benzene not exceeding 3,5 percent by volume and sulphur contents 0,03 per cent.

According to the draft of the Federal Law regarding the protection of population and environments from harmful effect of petroleum the sulphur contents are established for the following quality categories of petroleum:

- highest - sulphur content in diesel fuels is limited to 0.005 %;
- first - diesel fuels with sulphur contents not exceeding 0.01 %;
- second - diesel fuels with sulphur content not exceeding 0.05 %;
- third - diesel fuels with sulphur content not exceeding 0.2 %;

According to the norms adopted in these administrative acts the use of petroleums not meeting these requirements will be prohibited after 2000.

As to the possibility of the use of alternative clean fuels, in particular compressed natural gas (CNG) and liquefied petrol gas (LPG), Russia has some experience in the use of a combination of low-octaned gasoline and natural gas. Two-fuel system "liquid- gas" and "liquid-liquid" using the low octane gasolene with such high-octaned additives as spirits and ether is now under testing in a number of regions.

As regards the development and introduction of harmonized fuel consumption standards for motor vehicles, in particular passenger cars, in order to reduce CO_2 emissions no taxes for the carbon dioxide emissions now apply in Russia. Consumption standards for a type of motor vehicle are supposed to be introduced in the future.

There are serious problems in connection with older vehicles having service life expired, control of pollution of which is hindered. Russia is supporting the incentives for removal of old vehicle from service by scrapping in order to prevent the transfer of high pollutant motor vehicles from one country to another.

At the same time it should be stated that the recommendation takes into account the difficulties in the implementation of these recommendations especially in connection with the transition period for some countries. Meanwhile such recommendation on the whole are achievable taking into account its implémentation according to the scheduled measures.

All that defines the necessity of rising the fuel efficiency, introduction of clean kinds of fuel, wider use of railway, marine and river transport, new transport infrastructures, planning and investments in public transport and more stringent state regulation through the rules, standards etc.

At the same time there are serious problems connected with introduction of the alternative fuels as the manufacturers of motors traditionally use the technologies oriented on combustion of usual fuels. Still, a lot of facts is for the benefit of a shift to the alternative fuels instead of petrol and diesel fuels.

Financing

The concept of steady development directed on the environment protection, reduction of pollutions and use of recycled power sources today is considered as an integral part of the transport policy.

The existing finance programmes on the federal and regional levels are based on specialized funds and do not need significant budgeting appropriations and the use if need may arise credits on a return base. Such policy coincides with the economic interests of the participants of the programmes and directed to achieve considerable social, ecological and economical results directly connected with the environment improvement. It also envisages a system of regional payments and penalties for environment pollutions and ecological taxes, as well as insurances of ecological risks on the transport.

90 percent of the pollution penalty payments go to the state no budget ecological fund special accounts, 10 percent go to the income of the federal budget for the financing of the territorial bodies of the environment protection. It is planed also to create a state system of compulsory ecological insurances for forecasting failures and accidents and prevention of ecological impacts on nature,

The economic stimulation for environment protection is often managed through the establishment of some privileges allowed by the state for instance for the use of no-waste technologies and secondary resources.

Russia in its transport policy pursue the "polluter-pays principle" of the Helsinki Convention 1992 as applied to the transport sector, introducing differentiated "cost neutral" environmental taxes, charges and/or fees according to the ecological properties of fuels and vehicles. Russia offers similar methods as other countries for the achievement of the mentioned purposes. Such measures suggests introducing differentiated "cost neutral" environmental taxes, charges and/or fees according to the environmental properties of fuels and vehicles e.g. higher prices for leaded gasolenes and lower prices for unleaded gasolenes.

To bring the national rules and practices to the european standards it is considered properly to study separately the long-term and short-term measures intended to cut pollutant emissions and directed to the improvement of ecological requirements for automobiles, fuels, planning of development of the infrastructure, land use and the development and application of economic stimulus.

The realization of the steady development long-term strategy suggests using the existing technologies more efficiently and their perfection, an effective use of the existing transport capacities and a shift to ecologically safer types of transport.

NOTES

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2.Management Plan for Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs). First Edition Federal/Provincial Long Range Transport of Air Pollutants Steering Committee, Draft March 1990, pp. 163

3. Всесоюзная научно-практическая конференция "Проблемы энергетики и транспорт ", Труды ЦИАМ N 1272 . Москва 1990. 432 с.

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MINISTRY OF TRANSPORT AND COMMUNICATIONS
Sweden

Mats Ekenger 1995-01-26

Umwelt Bundes Amt/HELCOM

Workshop on the Reduction of Emissions from Traffic in the Baltic Sea Area, Rostock-Warnemunde January 23 - 27 1995

General loading situation in the Baltic Sea region and <u>contribution from the transport sector</u>

As a background document for the Baltic Sea Conference of Ministers of Transport figures on emissions of major air pollutants in the Baltic Sea region in 1990 have been estimated.

Atmospheric emissions of sulphur dioxide and nitrogen oxides have for many years been reported on a yearly basis to the European Monitoring and Evaluation Programme (EMEP) under the UN ECE Convention on Long-range Transboundary Pollution (LRTAP). Official data on those emissions can not be used for sectoral assessment purposes since they are only given as total national figures. (A task force on emission inventories within the LRTAP Convention is working to increase the quality of data.)

Acidification is considered to be one of the most important problems in northern Europe. *Lake acidification* effects are common in Norway, Sweden, Finland and adjacent areas of the Russian federation. *Soil acidification* effects are observed on poorly buffered soils especially in continental Europe and in the southern parts of Scandinavia. *Nitrogen deposition* contributes to the acidification by 30 - 50 % in forested areas in Germany.

Eutrophication effects are well documented in parts of Germany, Denmark and southern Sweden. Common effects are the disapperance of plant species, which preferably grow on alkaline soils and conversion of calluna dominated heathlands to grasslands. The main effect as regards aquatic systems is the gradual depletion of oxygen which ultimately kills marine life. *Nitrogen deposition* contributes to the eutrophication of terrestrial ecosystems as well as to the Baltic Sea.

Table 1. Total emissions of nitrogen oxides, sulphur dioxide and volatie organic compounds

In the countries surronding the Baltic Sea the transport sector contributes from less than 40 to more than 80 % of the total *NOx emissions*. The lowest contribution (40 %) occurs in Poland while the highest (82%) is in Sweden. Road traffic is the dominating source but domestic sea traffic and off road vehicles contributes significantly in many countries. In Norway NOx emissions from ships is almost as large (45%) as those from road traffic (47 %). Railways and air traffic are in most countries responsible for less than 5 % of the total transport sector nitrogen emissions.

The transport sector contributes with approximately 30 % of the emissions of nitrogen oxides in the Baltic Sea region, (60 % if on takes into consideration transboundary emissions.) It is estimated that the transport sector contributes with 10 % of the total nitrogen input into the Baltic Sea.

The transport sector is often neglected when considering the emissions of *sulphur dioxide*. However, in some countries transport (road and sea traffic) is responsible for almost 30 % of the sulphur dioxide emissions (Sweden). The transport sector contributes with less than 5 % to the total sulphur deposition in the Baltic Sea region. (Sulphur deposits are largest in Central Europe.)

Actual deposition is in most areas in the Baltic Sea region far above the *critical loads* of nitrogen and sulphur. Emission reduction of 70 % for nitrogen and 70 - 90 % for sulphur are necessary in order to get below the critical loads.

Model calculations indicate that emission reductions of at least 50 % for both nitrogen oxides and volatile organic compounds are necessary to meet the critical levels of photochemical oxidants in large parts of Europe. These findings includes the situation in the Baltic Sea region.

The *sensitivity of the ground and watercourse* to acidifiction is however greater in Scandinavia.

Figure 1. Sulphur content in rain
Figure 2. Sensitivity of the eco-system
Figure 3. Critical load of sulphur
Figure 4. Exceedance of the critical load of sulphur

Emissions of *carbon dioxide* is stated to be a global problem which ought to be tackled in international co-operation. In western Europe carbon dioxide emissions from traffic account for 25 - 35 % of the total emissions (OECD Environmental Data Compendium 1991). In Sweden however the figure is approximately 40 % and road traffic are the dominant source.

Recent studies in Sweden show considerable differences in cost for reducing carbon dioxide emissions in different countries. It is clear that allocation of measures to countries with comparative advantages in costs is socio-economic efficient. This is an example of benefits with a joint implementation of environmental measures.

Joint implementation means that one part (the investing country) invests in measures to reduce emissions, or in measures to reduce the growth of emissions, in another country in order to fully or partly be able to take credit of the reduction itself. The important point here is the possibility for the investing country to be able to credit itself for the reduction of the emissions even if the measure is implemented in another country. The receiving country is expected to sustain from claiming the reduction, since it is receiving a capital investement.

It is important to say that few countries have good data on transport and the environment. However, there are several examples where new information on the environment has caused a rethinking of environmental policy.

<u>The Baltic Sea Conference of Ministers of Transport</u>

The Baltic Sea Conference of Ministers of Transport started in March 1992 in Szczecin. Three working groups were established. One on infrastructure, Ways and Means to Develop a Common Vision of the Transport System and Infrastructure in the Baltic Sea Region, led by Poland, one on Road Safety led by Finland and one on Transport and Environmnet led by Sweden.

The Baltic Sea Region consists of Byelorussia, The Czech Republic, Denmark, Estonia, Finland, Germany, latvia, Lithuania, Norway, Poland, Russia, The Slovak Republic and Sweden.

The working groups have presented extensive reports. In order to make the recommendations and the material manageable to the conference in Kaliningrad in February 1994 a **synthesis report** was prepared. *It is focusing on principles where there is consensus between the working groups.*

It is interesting to note that this was an attempt to try to find common solutions acceptable from the point of view regarding increased transport efficiency and volume and gradual improvement of the environmental situation. Also, the report is avoiding recommendations which primarliy are of a national nature, or general statements. The recommendations shall be seen as possibilities especially valid for the Baltic Sea region. One conclusion was that the changing structure of production and the nature of personal needs of travellers will probably lead to an increasing role of road transport in serving national and international traffic.

The conference agreed upon a resolution. In an annex to the resolution it is stressed that local efforts to develop public transport should be supported. Actions on fuels is recommended to be raised in multilateral organizations. The importance of the railway system is emphasized. Short sea shipping is stated as a possible alternative to road transport. Maintenance and inspection programs on vehicles are considered as important.

The recommended measures will have an impact in different time perspectives. Short term proposals aim e.g. at better performance of existing vehicles and infratructure through software measures. Medium term propsals aim for increasing existing capacity by improvements in the infrastructure e.g. through better rail or road connection in harbours. Long term proposals aim at building new infrastructure such as expressways or lagre scale use of alternative fuels.

Objectives

The scope of the work has been to:

- describe the various environmental problems connected with transportation,

- describe existing international as well as national legislation and agreements in the field of transportation and environment,

- describe what measures are needed for sustainable mobility with due attention paid to the different conditions and prerequisites for policy change as well as technology developments that exists in the different countries,

- assess the harmonization possibilities in the region for improved emissions regulations and control measures for all modes of transport,

- assess the possibilities of introducing cleaner fuels in the region and

- to make an environmental impact assessement of the vision of a new transport system in the Baltic Sea Region.

Method

The approach has been to collect data. Duplication of work has been avoided and early contacts were taken with international institutions in order to get data and statistics.

Three consultants have made special studies. I have briefly summarized **Traffic and Air Pollution in the Baltic Sea Region** from the Swedish Environmental Research Institute.

The report from **Ecotraffic** about engines and fuels aims to describe the possible routes towards a transport system where alternative fuels and technology plays an important role in reducing the negative environmental impact from traffic.

The report from the **Wuppertal** Institute for Climate, Environment and Energy deals with alternative strategies to the traditional transport policy making in the western European countries. The aim is to describe how transport demand can be influenced and managed and how transport can be supplied in a more environmentally friendly way than at present occurs in the western European countries. The idea behind both reports can be summarized as an aim to find solutions which are more in cope with the environment than the present situation.

Representatives from the Helsinki Commission (HELCOM) and the Commission of the European Communities have participated actively in the work. Close contact with the working group on Ways and Means to Develop a Common Vision of the Transport System and Infrastructure and the working group on Road Traffic Safety has been maintained.

The basis for the proposals

The proposals are obviously influenced by the different prerequisites and possibilities in the north west countries and the south east countries of the region both from an economic, technological and political state of view. The basis for the discussion has been whether the north west countries of the region should start to take serious steps towards sustainable mobility and whether the south east countries of the region, in their transition to market economies, have the ability to avoid the same environmental problems as the western countries in Europe and find their own ways to sustainable mobility. The question of traffic growth causes a real political problem in the choice between people's need for mobility, the transport demand from industry and the protection of the environment.

In brief you can say that there is a fear in the south east countries that their economic development and the development of their infrastructure will be restrained by environmental restrictions imposed by the north west countries. There is a fear in the north west countries that the economic development in the south east countries will take place without appropriate environmental concern. Therefore, a pragmatic view is, that proposals regarding software and hardware infrastructure improvements in the Baltic Sea region should take place under an environmental ceiling.

Transportation is necessary for economic development and it is a social need in the society. On the other hand transportation cause negative environmental impact and congestion. The overall objective must be to maximize the total benefit for the society.

Transportation policies in highly industrialized countries have given high priority to increased mobility with little attention given to the environmental consequences. New infrastructure has been built due to its contribution to economic development, growth and productivity in general. The basis for this choice has been, above all, reduced travel time for passenger traffic and reduced time, increased flexibility and increased "just in time" performance for freight transport. Low price on transport and expansion of the road network have been considered as prerequisites for economic growth.

Transport involves costs for society in order to construct, maintain and manage infrastructure and transport facilities. It also brings socio-economic costs due to external effects such as pollution, noise accidents, congestion and intrusion. These costs are partly born by others in the transport system.

Although emission and noise standards for automobiles were introduced in some countries already in the beginning of the seventies, and have been significantly tightened since then, technical improvements on cars have been upset by traffic growth. Hence a continuation of a supply-oriented approach - with its emphasis on gradually expanding transport infrastructure, especially for cars and trucks, will not be compatible with sustainability.

A prerequisite for demand management is internalization of social costs. In a transport policy based on market economy principles efficiency and access in the transport sector are determined by transport demand from people and industry. A free transport market is advantegous since it is only the individual consumer or producer that is able to take a rational decision and that the decisions are decentralised. The freedom of choice however needs a socio-economic price setting in order to reflect the right decisions from the society's point of view.

"Business as usual", i.e. continuing a supply oriented policy primarily based on expanding the infrastructure will not be sustainable or solve congestion problems.

There is no simple answer to the question of an optimum level of road transport. Individual passenger car use today in western Europe meet individual benefits. Analyses of passenger car trip purposes in highly motorized countries indicate that most traffic is rather a consequence of high incomes than connected to economic growth. Leisure driving and shopping cause more than half of the mileage traveled by cars.

To move from the present-day situation to sustainable mobility will require a series of combined policy measures:

- better use of available technology and continuing technolgy development on engines and cleaner fuels,

- more efficient use of existing capacity and infrastructure,

- shifting to environmentally friendly modes of transport and public transport,

- reducing the volume of transport.

Emissions are gradually beeing reduced by better technology and cleaner fuels. The total amount of traffic however is growing at a faster rate than technological improvements.

Fuels

New sources of fossile fuels are not found in the same speed as they are used. Therefore more expensive methods of extracting crude oil and natural gas will occur. Renewable fuels are not likely to be able to supply the market with current refining technology. In addition the tax system favours fossile fuels. It is important to conclude that engine technology development is not an obstacle to alternative fuels.

Calculations from Ecotraffic shows that bio-fuels could be an alternative to fossile fuels in the Baltic Sea Region under certain conditions. These are investments in infrastructure and distribution and a taxation based on internalizing the environmental costs of fossile fuels.

Economic instruments

In order to limit the growth of road transport there is a need for measures that influence the choice between different modes of transport. It is important to note however, that the main part of air pollution in the transport sector originates from short distance transportation. The possibilities to substantially reduce emissions by shifting long distance transportation from road transport to rail and sea transport are limited. This is absolutely true if transport poicy is governed within the concept of market economies.

An effective tool to influence the mode of transport is economic instruments. Internalization of the social costs of transport means that the modes of transport giving rise to the various forms of damage are made financially liable. Another term for this view is the polluters pays principle. It is possible to create a market for cleaner and more energy efficient vehicles by using environmental taxes and charges.

Economic instruments should be used to change behaviour both in the choice of transport mode and in car use. A step-by-step introduction is important in order to minimize distributional effects and to avoid conflicts with the social values of transportation. The public should be duly informed about the true costs of transport to gain support for raising taxes. The tax policy also give signals to the car manufacturing industry about what type of cars the market will demand.

Environmental goals

One important prerequisite for a policy on sustainable mobility will be the adoption of distinct environmental objectives. Without clear qualitative and quantitative objectives any policy pursued will be vague. Setting goals shall be seen as the starting point of a process. However, it has failed many times since it can be seen as a threat or an obstacle to development. One problem with environmental goals are that they may be set at an unrealistic level impossible to meet, resulting in contra productive effects.

One possibility discussed by the Baltic Sea Conference Ministers of Transport is to set goals for south east countries, for a transitional period, where they should be allowed to take into account their much lower car density. It would for example not be reasonable to require implementation now in the whole Baltic Sea region of the north west emission standards. One way to reach equity would be to set an emission limit for each country based on an average limit per capita for CO_2, NO_x and VOC-emissions from road traffic. The average per capita emissions are generally much lower in the south east countries than in the north west countries. A limit based on the present north west countries per capita emissions would give room for an increase in traffic volumes in the south east countries. The per capita limit should decrease over time as traffic grows.

A national program for sustainable mobility can be defined in each country by formulating objectives for the main disturbances and forms of damage for which transport is responsible. Such a view is well reflected in the Fifth Action Programme on Environment of the EU (1993). Objectives should be defined for at least the following:

- air quality in urban areas,
- emissions of nitrogen oxides, volatile organic compounds and sulphur,
- emissions of carbon dioxide,
- noise and safety.

Environmental policy must be based on what nature can tolerate in the long run. The strategy must for that reason follow the precautionary principle.

The main strategic proposals

* The Ministerial Conference is recommended to adopt the polluters pays principle and the need for internalizing social costs of transport.

* The Ministerial Conference is recommended to agree to study the principles of full-cost pricing. Such a study should aim at exploring different types of taxation based on environmental standards.

* The Ministerial Conference is beeing advised to set up a special working group related to the development of the public transport systems in the region.

* The Ministerial Conference is recomended to establish a special joint task force to explore further the possibilities of introducing alternative fuels, notably based on biomass. The task force shall investigate production possibilities in the south east countries of the region.

* Fuel development plans for cleaner fossile fuels and alternative renewable fuels should be set up and include programmes for improved refinery capacity.

* Exhaust emission control to ensure appropriate maintenance of emission related vehicle parts, regularly inspection and maintenance programmes should be implemented.

* Modernization of existing railway systems in the eastern countries of the region should have top priority.

* Support development of sea tranportation in the Baltic Sea.

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* The south east countries of the region should meet EU-standards on fuel quality by the year 2000.

* The south east countries of the region should meet EU-standards on locally produced vehicles regarding exaust emissions by the year 2000.

  Special attention is needed in urban areas for introduction of low NOx and particulate standards for buses and delivery trucks.

* Leaded petrol should be totally phased out by 1995 in the north west countries and in the south east countries by the year 2000. In the south east countries the lead content should be limited to 0,1 g per litre petrol by the year 1995.

* The sulphur level in diesel oil shoul be limited to 0,05 % by 1995 in the north west countries and by 2000 in the south east countries. By 1995 the limit should be 0,3 % in the south east countries.

* Environment and safety aspects should be covered in any investment calculation.

* Increase capacity of existing infrastructure through software measures

* Special attention should be given to the difficult situation at many border-crossings.

At the same time as the Baltic Sea Conference of Ministers of Transport, and still running, a project on a Vision and Strategies around the Baltic Sea 2010 has been set.

In the year 1992 representatives from national and regional ministries of the Baltic Sea Region responsible for environment protection and for spatial planning met in Karlskrona. It was decided to jointly prepare a document on a spatial development concept: Vision and Strategies around the Baltic Sea 2010 (Towards a Framework for Spatial Development in the Baltic Sea Region).

The proposals in the the project are stated at an aggregated level. However, apart from the proposals from the Baltic Sea Conference of Ministers of Transport, the propsals are approaching special types of areas or special prerequisites in cities and rural areas.

Proposed common actions:

- arrange regular meetings for ministers
- make proposals for selected pilot projects
- make financial arrangements required for the action programme
- design a marketing effort for the BSR at the international level
- elaborate a research programme
- organise a joint conference among the "European" and the Baltic Cities for common marketing and co-operation
- launch a research programme om weakness and potentials of the urban network in the BSR
- identify possible locations of multimodal transport centres (togehter with the BSCMT)

- identify further needs to improve port hinterland infrastructure (togehter with the BSCMT)

- promote a pilot project on potentials to strengthen spatial cohesion through new forms of telecommunication

- assess potentials for further cross-border co-operation

- encourage pilot projects for cross-border co-operation with spatial planning component

- elaborate guidelines for spatial planning in the coastal zone

- elaborate a harmonised concept for the development and protection of valuable natural and cultural landscapes in a BSR network

- organise dicussions with EU on spatial development and planning policies

- prepare a synoptic review of spatial planning and implementation concepts in the BSR countries at national and regional levels

- encourage demonstration projects for the application of EIA at an early stage in the planning process

- enter a concerted dialogue with countries involved to design appropriate training and technical assistance concepts.

In the year 1994 the Swedish Ministry of Transport and Communications has taken an initiative to establish Bilateral agreements on exhaust emissions from ships.

In a Bill 1990/91:90, A living environment, the Swedish government proposed stricter regulations concerning the sulphur content of fuels used in ferries and other vessels which frequent Swedish ports through wide-ranging Nordic co-operation. Bilateral agreements should be reached as a first step with the objective that all Nordic ferry traffic should be included in the agreement on maximum sulphur content at a later date. Emissions of nitrogen oxides from shipping should also be reduced.

As a result of voluntary agreements, several ferry companies have begun to use more environmentally sound low-sulphur bunker oil. However, it is the Swedish experience that when business are going down the companies tend to buy cheaper oil.

The Swedish government has now called upon a special investigator to prepare for bilateral agreements regarding frequent traffic in the Baltic Sea between Sweden, Finland, Denmark, Norway and Germany. Discussions have also started with Poland in this matter.

The reductions of exhaust emissions are planned in two steps. First a reduction of sulphur to a maximum level of 0,5 % by weight on all ferries and other regular sea lines. The second step involves measures for a 90 % reduction of nitrogen oxides by means of exhaust aftertreatment equipment to equal standard of SCR.

The total potential reduction of nitrogen oxides are estimated to 55 000 ton and of sulphur 4 100 ton per year (includes reductions from lines between Sweden and Russia, Estonia, Latvia and Lithuania).

A possible outcome of the forthcoming annex to MARPOL 83/98 on air pollution, is the establishment of the Baltic Sea Area as a special Area, subject to limitation of sulphur in fuel for all shipping. If the present discussed limit on 1,5 % sulphur in bunker oil is established and bilateral agreements can be reached, the total reduction of sulphur emissions from sea traffic in the Baltic Sea is estimated to 45 - 50 %.

Another target set by IMO is a reduction of 30 % in nitrogen oxides emissions from ships. If this is achieved on all ships not subject to bilateral agreements, the total reduction can be estimated to 60 % in the Baltic Sea.

The question of Transeuropean networks is high up on the agenda in the European Union.

As new members of the European Union Sweden is prepared to actively work for an integration of environmental aspects on transeuropean networks. It is important that cleaner fuels and non-fossile fuels can be introduced in a lager scale on the European market.

In the field of urban travel there is a need for special considerations. Proposals regarding urban traffic can be collected from the CEMT/OECD Urban Travel and Sustainable Development (draft Final Report mar 31, 1994, (CEMT/CS(94)16, CEMT/CS(94)23).

Main findings

Car dependency in cities can only be reduced by the combined effect of land-use planning and transport policies. The goals of such plicies will need to be openly stated. Their implementation will need to be steady and long term. An integrated policy approach is essential. Three main strands of such a policy package can be identified:

- Best Practice

  Raise the effectiveness of current land-use planning and traffic management measures, including parking control and provision/encouragement of other means of transport, to the level of those in the best managed cities. This strand is a necessary part of a coherent strategy, but will be insufficient to bring major benefits on its own.

- Innovations

  Develop new policies to shape urban developments into less car-dependent forms and apply congestion pricing to traffic management, with the objective of bringing demand for car travel inte balance with road capacity.

- Sustainable Development

  Introduce repeated annual increases in motor fuel taxation to promote more economical vehicles, a shift in travel away from solo driving and greater use of envronmentally-friendly modes.

All three strands of the policy package are necessary to reduce car travel, especially in cities, and to achieve sustainable urban development. Together they could cut the economic, environmental and social costs of travel in OECD countries by up to 2 per cent of GDP.

The work started 1991 and has proceeded along two main approaches, land use planning and the possibility to use economic instruments. A comprehensive material has been produced. The main sources on which the report is based are 18 overviews of national policy, a questionnaire by 132 cities, case studies of 12 cities, a series of issue papers, a conference on "The Use of Economic Instruments in Urban Travel Management" in Basel 1992 and a seminar on "Travel in the City" in Dusseldorf 1993.

International trends

A new international dimension on transport policy is the concept of sustainable mobility. In the year 1992 the European Commission published its policy plan on transport, the Future Development of the Common Transport Policy. It stated that current trends in transport development are not sustainable and that the price on transport are too low. On the other hand the Common Transport Policy concentrates on the completion of the internal market. Some main issues are harmonization and the creation of trans-european networks.

It is without any doubt that a uniform European policy in these fields will increase road transport volume further and that this has to be balanced through a socio-economic price setting. The business community often argues that transport growth is a prerequisite for economic growth. This creates a problem regarding the socio-economic need to increase the costs of transport. In the long term, it will become evident that it will be more economical for the society if the benefits of transport can be met with less transportion. This ought to be true even for private business.

<u>Economic instruments</u> is also a matter in transport and environmental policy which is high up on the agenda both on a national level and in international organizations.

As an example HELCOM PITF decided at its meeting in Hamburg 1993-05-25--28 to create an Ad hoc working group on economic instruments. The following issues have been investigated:

- possibilities to introduce coordinated economic instruments in order to reduce inputs to the Baltic Sea,

- possibilities to create financial means to accomplish some of the investment needs in the Baltic Sea Joint Comprhensive Environmental Action Programme,

- possible legal and institutional arrangements for their implementation.

In the introduction of the project there is stated that economic instruments need a well defined context. This means relevant legislation, institutional and technical support for monitoring, billing, collecting and evaluation. In a wider context there is a need for a stable macro-economic situation in order to use economic instruments. Many countries have had problems with fees lagging behind inflation.

Both shipping and air traffic in the Baltic Sea area are sources of NOx deposition. *It is interesting to note that the group recommends that the possibility of introducing NOx fees on air traffic and shipping, similar to the ones on stationary sources, between HELCOM countries should be considered.*

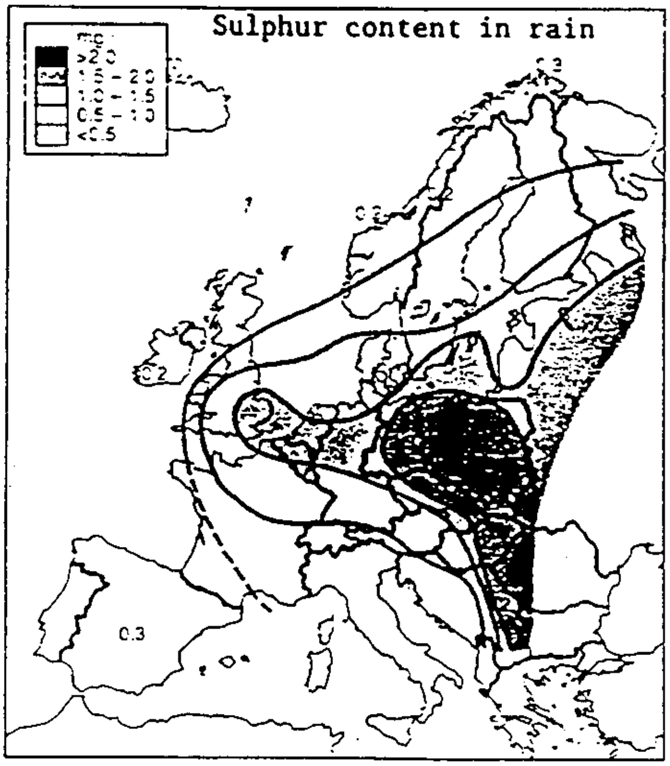
NOx-emissions from road traffic is a major problem in all west-European countries and an emerging problem in the countries in transition. Introducing catalytic converters in all countries around the Baltic Sea is therefore of great importance. Since cars with catalytic converters need unleaded gasoline, it is desirable that such gasoline is cheaper than leaded gasoline.

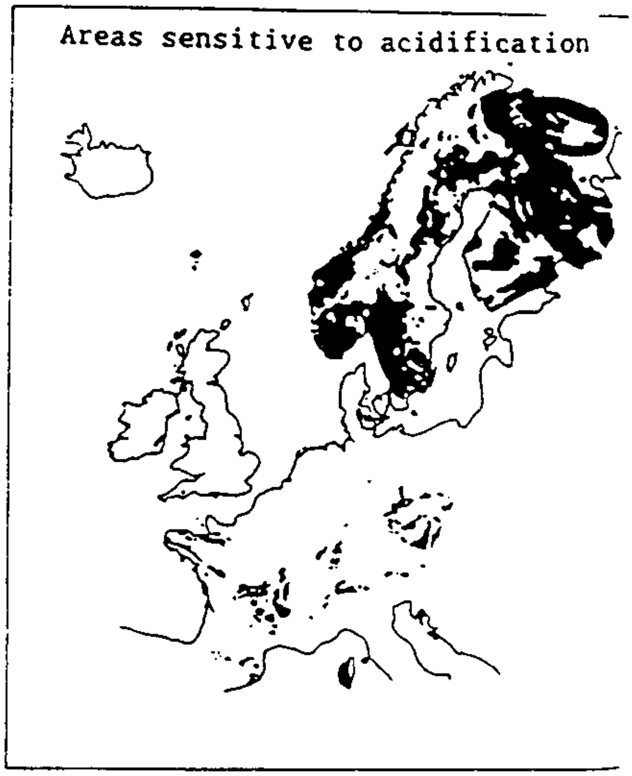
Furthermore, when introducing cars with catalytic converters in the west European countries, sales or excise tax differentiation between new cars with catalytic converters and older ones without have been an important tool to limit the extra cost of these cars. The group recommends that taxes on leaded and unleaded gasoline should be differentiated in favour of unleaded gasoline. The group also recommends that the possibility of introducing sales tax reductions or excise tax reductions for new cars with catalytic converters should be considered, in countries where such devises are not compulsory.

Table 1. Emissions of major air pollutants in the Baltic Sea Region in 1990 or the closest year for which data have been obtained. Values in 1000 tons. Details on the data are available in Appendix 1.

Country	No_x total	No_x traffic	SO_2 total	SO_2 traffic	VOC total	VOC traffic
Denmark	284	140	181	12	201	98
Estonia	65		206			127
Finland	291	176	261	9	205	51
Germany	3412	2180	6244	110		2060
Latvia	35		70			
Lithuania	59		238			
Norway	230	180	54	11	270	103
Poland	1280	514	3210	54		330
Russian Fed.	4248		8416			
Sweden	404	332	126	37	456	153
The Baltic Sea	80	80	72	72		

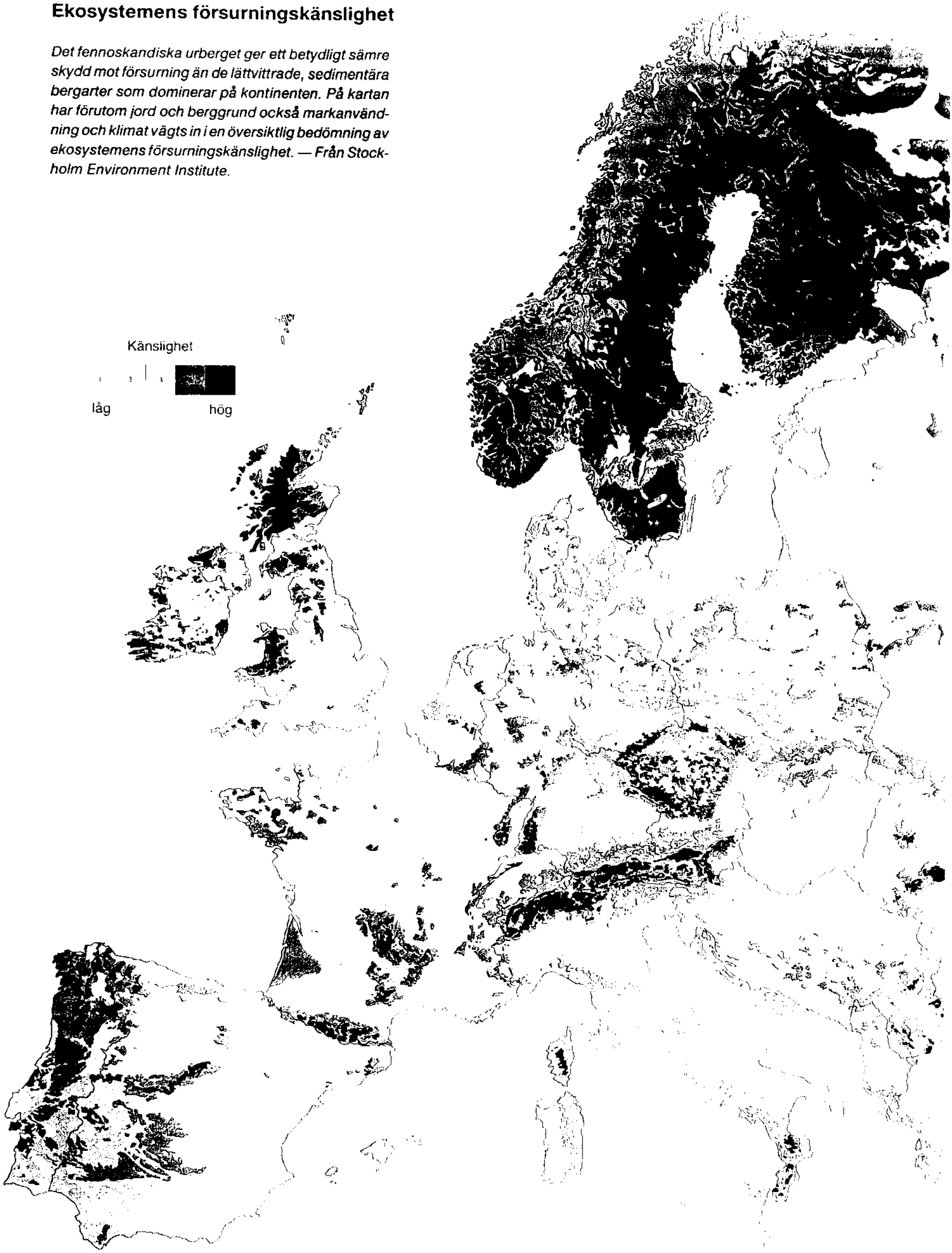
Figure 1. The size of the deposits varies amongst different countries. Sulphur deposits are largest in Central Europe. The sensitivity of the ground and watercourse to acidification is, however, greater in Scandinavia, which means that problems connected with acidification can more easily occur there (source: Swedish Environmental Research Institute).





Ekosystemens försurningskänslighet

Det fennoskandiska urberget ger ett betydligt sämre skydd mot försurning än de lättvittrade, sedimentära bergarter som dominerar på kontinenten. På kartan har förutom jord och berggrund också markanvändning och klimat vägts in i en översiktlig bedömning av ekosystemens försurningskänslighet. — Från Stockholm Environment Institute.



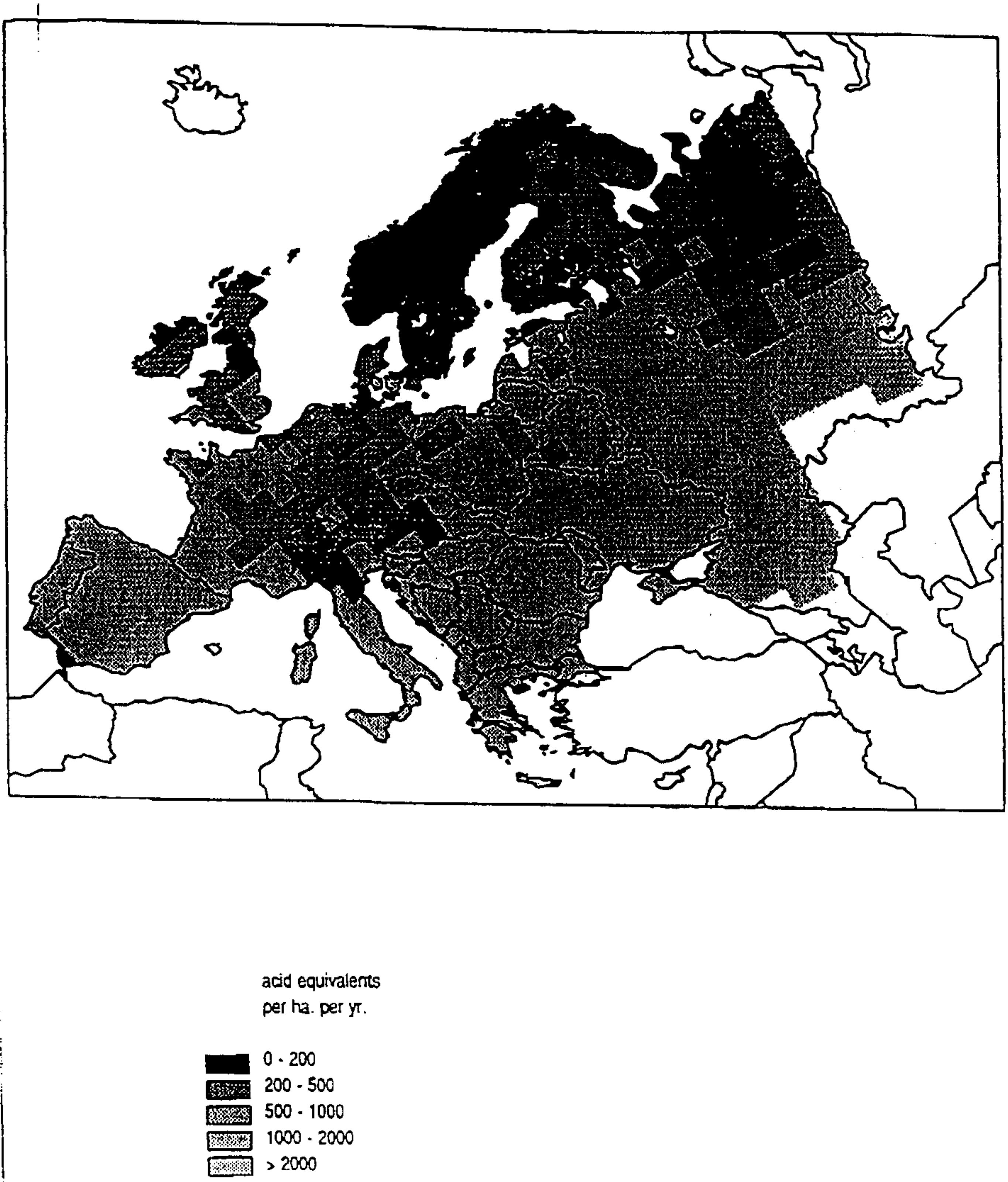


Figure 1. *Critical load of sulphur (5 percentile).*

The map shows the sensitivity of ecosystems to sulphur deposition. The figure indicates how much sulphur deposition ecosystems can tolerate without sustaining long-term damage. More sensitive ecosystems have lower critical loads, shown as darker regions on the map. The values shown are calculated to protect 95% of the ecosystems in each grid cell.

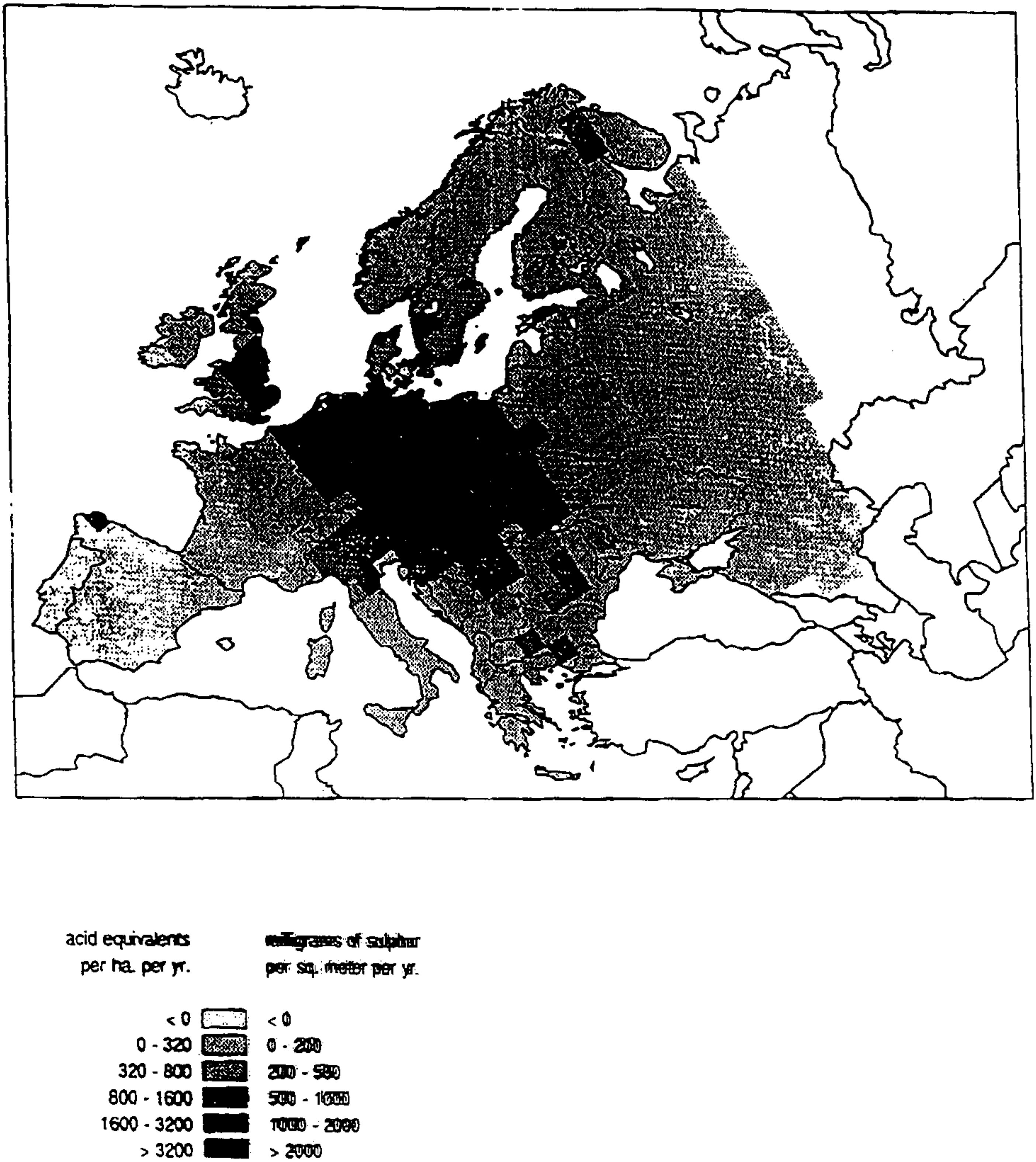


Figure 2. *Exceedance of the critical load of sulphur in 1990 (5 percentile).*

The map shows the levels of excess sulphur deposition that can lead to ecosystem damage. The map compares the critical load values (from Figure 1) with sulphur deposition in 1990. Higher values indicate areas where excess deposition is highest.

Naturvårdsverket
Swedish Environmental Protection Agency
Traffic section
Lars Westermark

Datum
1995-02-10

HELCOM - Workshop on the reduction of Emissions from Traffic in the Baltic Sea Area
Rostock-Warnemünde, January 23rd to 27 1995

Presentation from Sweden on the present situation concerning traffic emissions etc

Traffic development and environmental impact

Sweden have had, during the last 30 years, a development in the traffic systems that we share with most European countries. Transport have been considered important for:

- regional policy, transport is the means to overcome disadvantages from distance.
- productivity, the functioning of the labourmarket and industrial development is dependent on an efficient transport system - however this thesis have now been questioned by some economists
- the well beeing of the citicents, leisure travel is for the moment the fastest growing part of the transport sector.

The private car has enabled people to increase there mobility. This has in turn had consequences for the physical planing of societies. New dwellings is build in a more dispersed pattern, witch undermines the base and economics for public transport. The dependence on the car has increased. As an example, the number of people in the Stockholm area that has access to public transport within 500 m from their place of living have decreased with, in the range of 20 %, during the last 20 years.

Air traffic increased with 10% yearly during the 80-ies - a rate that now has declined. Projections point on a 5% increase in Air traffic during the coming ten years. So far, emissions of NOx has increased i proportion to traffic growth.

Goods transport increased dramatically from 1960 to med 1970 ies and has since then fluctuated with the economic trends. Rail transport has a reasonably high market share in domestic transport 33%. Road transport dominates with a market share of 55% and ships 12%.

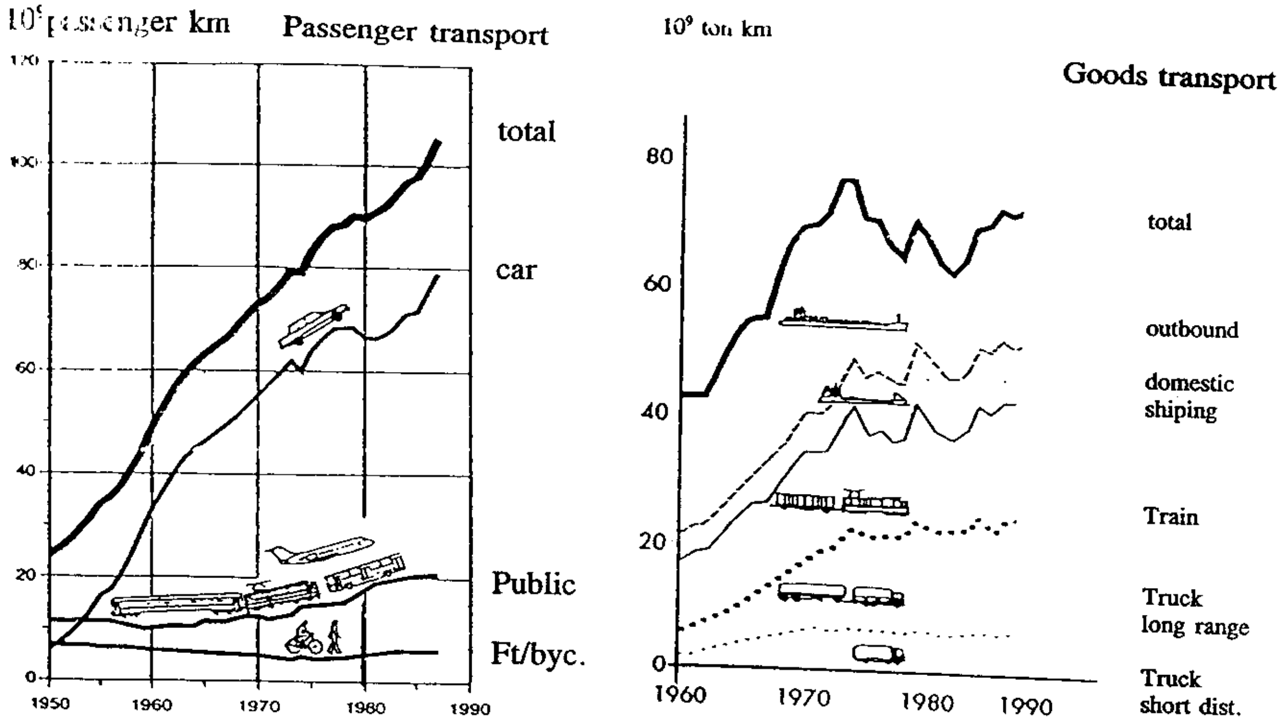


Figure 1. Transport development i Sweden

Looking at this development from the perspective of the environment, we may first consider the number of threats to the Environment in which traffic plays, in some cases a dominant roll.

Threats to the Environment

- Climate change
- Acidification
- Eutrophication of soil, freshwater and the sea
- Ground level ozon and other photochemical oxidants
- Air pollution and noise in urban areas
- Metalls
- Toxic organic pollutants
- Depletion of the ozon layer
- Utilisation of natural resourses
  Land and water use
  Exploitation of land for building, infrastructure etc

The scale of the problems is such as no single country can alone aleviate its own problems. Let me give an example of what is needed on a European scale to halt the ongoing acidification of lakes and land.

In the figure; A shows the present situation concerning acidified lakes; B shows the situation 2020 if todays international agreements are fulfilled, C shows a scenario where the deposition of SO2 and NOx has increased from today. We have estimated that the emissions of sulphur and NOx must decrease with 70 % to maintain today situation to the year 2020.

This illustrates the dilemma that Environmental protection faces - we are asking for sacrifices today,(higher costs, restrictions on mobility) in order to improve the Environment in the future, or even to only preserve the present situation.

Transportation as an major contributor to Emission related environmental problems is illustrated in the next tables and figure.

Emissions from transport in Europe - share of total[1]

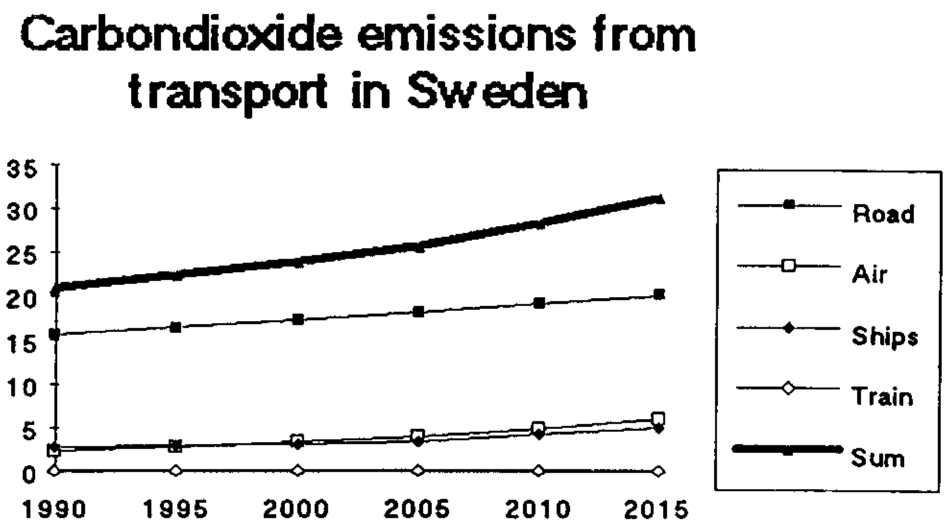
	1990	2000	2010
VOC	40%	40%	40%
SOx	20%	25%	25%
NOx	60%	55%	60%

Emissions from transport in Sweden - share of total

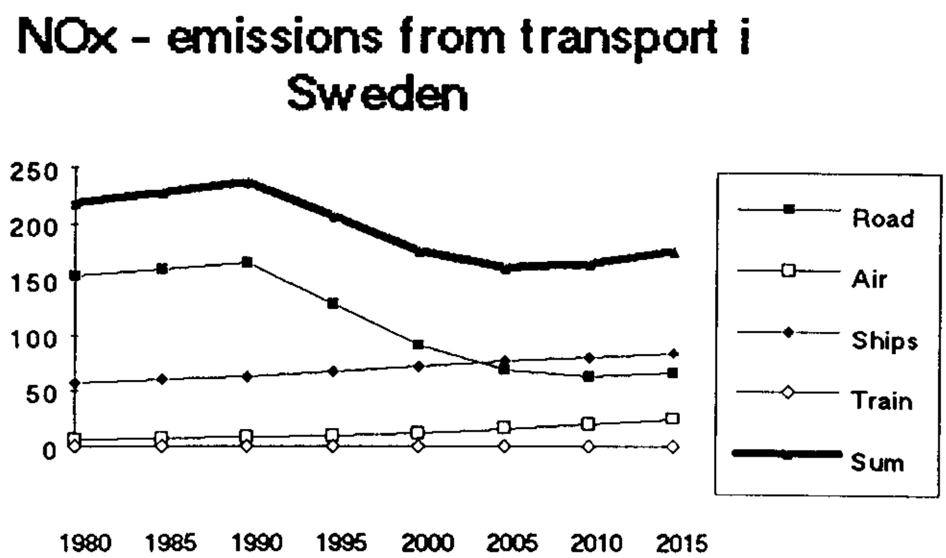
	1990	2000
VOC	38%	30%
SOx	28%	34%
NOx	81%	82%

[1] Non road machinery is included

Emissions from ships and non road machinery is an increasing concern. The emissions from these sources are very large(ships 16%, non road mach. 20% of total). The projections of future emissions are based on the decisions in environmental policy that are made up to now,(see below).

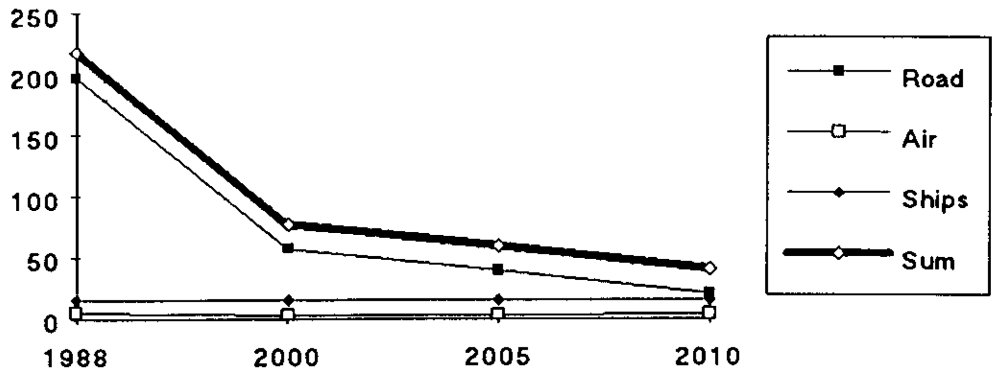


The increase of emissions reflects the traffic growth that is projected for all modes.



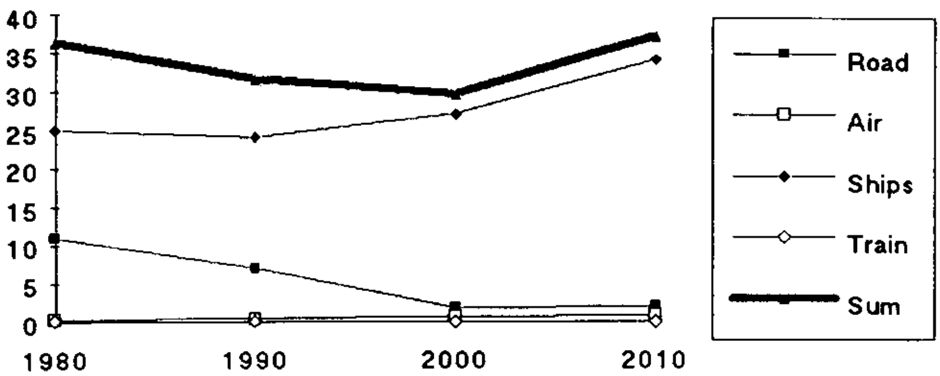
The measures that are decided taken together are projected to decrease NOx emissions from traffic(all modes) with hardly more than 30 % by the year 2005 compared to 1980 year level. If no further development is taking place, the traffic growth will bend the curve upwards again, in the years after 2005.

VOC- emissions from transport in Sweden



There seems to be possibilities to cope with our goals for emissions of VOC. Some sources has still to be combated. Emissions from leisure boats are one such case. There are indications that emissions from petrol driven motors for leisure boats can be harmful to aquatic life if the concentrations of pollutants are high enough.

Sulphur (SO2) - emissions from transport in Sweden



The future emissions of sulphur from the transport sector is synonymous with emissions from ships.

Measures and incentives in Sweden

Stringent emission regulations(in practice demanding catalysts) were enforced in Sweden from 1989 for passenger cars and from 1993 for heavy duty vehicles. The regulations have until now been based on federal US regulations as in most EFTA countries. One very important component of the regulations are, the durability requirements. The manufacturers warranty for the emission control equipment covers the full cost for repairs needed to pass an inspection for the first 5 years of vehicle life or until the car has been driven 80.000 km. This is, in the case of the passenger car. There are other limits for heavy duty vehicles or for vehicles in environmental class one or two.

Enforcement of requirements

■ Certification/type aproval	■ Test procedure ■ limit values
■ Conformity of production	■ Qaulity assurance audit ■ Driving cycle test ■ Corrective action
■ Durability requirements	■ In use compliance tests ■ Manufacturers warranty ■ Recall/Corrective action
■ In use requirements	■ maintanance and inspection

In addition to the mandatory requirements there are two sets of emission standards for voluntary application, environmental class one and two. The requirements i in the better classes are more stringent and the manufacturers warranty for the emission control equipment is prolonged. The voluntary levels are based on US standards and the Californian Low-emission program. The sales tax has been differentiated as to equalize the cost that the more advanced control systems may incur on the car price.

Likewise, diesel fuels have been divided into three environmental classes. Parameters such as sulphur content and contents of aromatic compounds are substantially lower in the better classes. For petrol is now a class two petrol available and work is going on to develop a class one petrol. Tax incentives has been applied, i.e the fuel tax is lowered i environmental class two and one. All petrol sold in Sweden are leadfree from the summer 1994.

The classification system is now beeing revised due to the Swedish membership in the European Union

The swedish experience show that there are substantial further benefits to gain from the application financial incentives in combination with classification systems in environmental policy.

Further incentives in Environmental policy

■ Two additional voluntary Env. classes for passenger cars, light duty trucks and heavy duty trucks	■ Sales tax are offset (is now beeing revised)
■ Diesel fuels in three Env. classes	■ Differentiated fuel tax
■ Petrol in two classes - a class one petrol is beeing developed	■ Differentiated tax
■ General incentive	■ Carbondioxide tax

- Emission and CO_2 tax on domestic flights
- A ban on leaded petrol from mars 1995

Technology for reducing emission from ships is available, the problem that has to be addressed internationally is how to apply the proper incentives in order to get such equipment installed in ships. In the case of non road machinery the ongoing work in the EC-commission based on earlier work in ECE/wp29 will hopefully result in emission regulations in accordance with the stringency achieved for heavy duty vehicles. The Technology on motor vehicles can be developed further. Next figure gives examples from bus engines that is in use for experimental/demonstration purposes in Stockholm

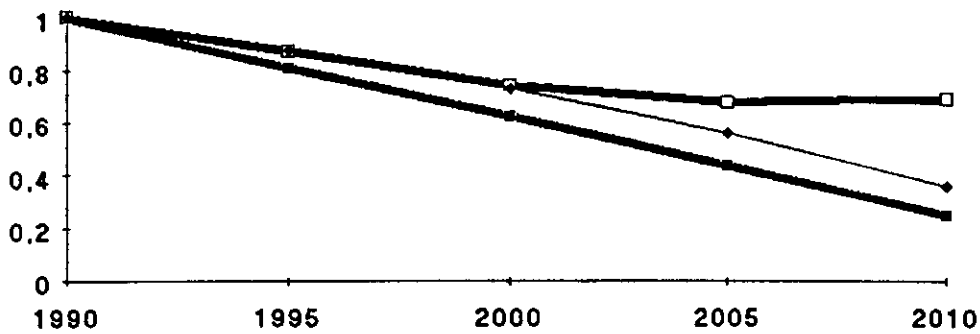
Engine type	Emissions according to ECE R 49	
	PARTICULATES g/kWh	NO_x g/kWh
Old bus	0,15	15
Natural gas bus (Volvo)	0,05	2,0
Ethanol bus (Scania)	0,05	4.2
LPG bus (Volvo)	0.01-0.05	2.1
Diesel bus (Scania)	0.1	6.3
EURO 2 European stand. from 1/10 -96	0.15	7.0
Env. class 1 och 2	0.15	7.0

We can conclude that there is technical potentials to achieve further reductions of emissions. In the next example I will illustrate the case where the full estimated technical potential for NOx reduction 2010 compared to 1990 is used.

Reductions from ships:	-90%
Red from passenger cars	-90
Red from trucks	-80
Red from aircraft	-15

The lowest thick line in the figure below represents full technical potential. The upper thick line is the projected emissions. The thin line in the middle is the full technical potential with the traffic growth added. Two conclusions can be drawn - technology may be advanced, the difficulty is to use strong enough incentives with respect to other considerations, for instance trade policy. The other conclusion is - technology alone will not solve all environmental problems where transport is a major contributor.

Technical potential - NOx emission reduction



Goals and achievements

The needs for emission reductions in europe are huge.

	Needs	Projected 1990-2010
VOC	-75-80%	-40%
SOx	-75-90%	-45%
NOx	-75-80%	-25%
CO2	-80	?

The reductions agreed upon so far must be considered as important steps but there is still a long way to go before we reach a state where the load of pollutants is below what man an nature can tolerate in the long run. I the case of the transport sector it is obvious that the goals for emission reductions is a challange to the sector if we are to reach the overall objectives.

International agreements(LRTAP) on reduction of emissions

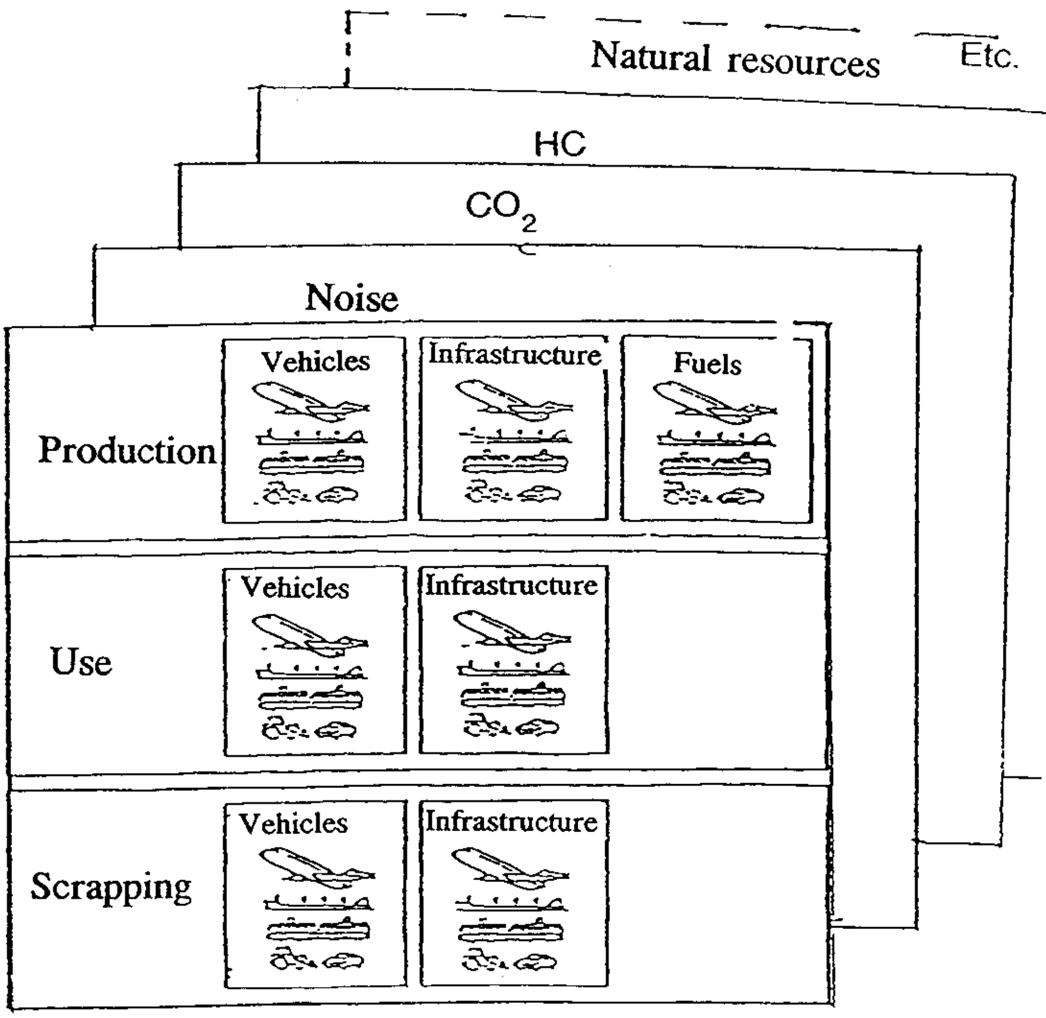
VOC	-30%	1988-99	✓
SOx	-50%	1980-2000	✓
NOx	0%	1987-94	✓

Undertakings for Sweden

VOC	-50%	1988-2000	✓
SOx	-80%	1980-2000	✓
NOx	-30%	1980-1995	No, but to 98

Development of the work with Traffic and Environment

Traditionally we have dealt with emission caused by the traffic itself. A more developed strategy for a transport system adapted to the environment must consider the whole range of environmental problems caused by transport and include the transport system as a whole, i.e vehicles infrastructure and fuels. A life-cycle perspective is needed in order to secure that emissions or other problems is not moved to other parts of the society.



The overall environmental needs must be broken down to operational goals for the transport sector, and perhaps even to each traffic mode.

To reach the environmental goals it is necessary that all actors work in the same direction - environmental protection must be integrated within the activities of the actors in the transport sector.

Many studies of transport and environment has been performed during recent years. Often these studies have been concentrated at one problem at a time or otherwise been to narrow in scope.

The Swedish EPA have initiated a joint work with all concerned actors in the transport sector. We have asked ourself three basic questions.
On the basis of the different studies above it should be possible to design a long term action programme. The work will be coordinated with the work of a paralmentary committee that has, according to its terms of reference to submit a proposal for a national plan for communications. The proposal will be presented in december 1996. The plan shall according to the terms of reference be directed to support an environmentally compatible transport system. Chairman for the committee is Mr Rolf Annerberg, Director-General for the Swedish EPA

1 What do we mean by -a transport system adapted to the environment ?

- develope short and long term operational environmental goals

2 What can it look like ?

- Scenariostudies

concerning
* mobility
* the mix between modes of transport
* what can be done within each transport mode
* technical development of vehicles and fuels
* the land use

3 How to achieve it ? - by what means

- Actionprogramme

* Administrative regulation
* Economic incentives
* Information

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