European Topic Centre on Air Emissions

CORINAIR 1990 SUMMARY REPORT 1

By

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PREFACE

CORINAIR 90 is a study of emissions of air pollutants in Europe. It was initiated by the European Environment Agency Task Force and was part of the CORINE (COoRdination d'INformation Environmentale) work programme set up by the European Council of Ministers on 27 June 1985 (Decision 85/338/EEC). The CORINAIR 90 inventory has been completed by the Euroipean Environment Agency's Topic Centre on Air Emission (ETC/AE) as part of the Agency's work programme.

The aim of CORINAIR 90 was to produce a complete, consistent and transparent emission inventory for the air pollutants:

- sulfur oxides (SO_x as SO_2)
- nitrogen oxides (NO_x as NO_2)
- non-methane volatile organic compounds (NMVOC)
- methane (CH_4)
- carbon monoxide (CO)
- carbon dioxide (CO_2)
- nitrous oxide (N_2O)
- ammonia (NH_3).

In addition to the twelve EU countries in 1990 (Belgium, Denmark, France, the former West Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain and United Kingdom), the five EFTA-5 countries (Austria, Finland, Norway, Sweden, Switzerland), the ten PHARE countries (Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovak Republic, Estonia, Latvia, Lithuania, Slovenia) and Croatia, Malta and former East Germany have been participating in CORINAIR 90. Data for Belgium are reported for the whole country and separately for the Flemish and Wallonie regions. For Croatia only for SO_x and NO_x data were available in the database and are thus reported. For the other pollutants summary tables were delivered by Croatia, which are presented

in a separate annex. Therefore SO_x and NO_x data are presented for 31 different countries / regions and data for the other pollutants for 30 countries / regions.

The former West and East Germany are presented separately and the former East Germany has been excluded from EU-12 but included in EU-15 since the reunification of Germany did not occur until October 1990.

This emission inventory is based on the data gathered by national experts in individual countries and prepared according to a common format supplied by CITEPA (France). It is the willingness of the countries involved and their national experts to participate which has made this first European emission inventory possible.

All countries (with the exception of Switzerland) have notified the EEA that their CORINAIR 90 inventory is final. "Final" means that the inventory has been submitted to a number of consistency checks, adjustments and updates and no further changes are expected from the national expert. However, minor adjustments may be made to improve consistency between countries before publication of the Final CORINAIR 90 Report. The data for EUROPE (including all countries) and for the EU-12, EU-15 and EFTA-5 groups are also only provisional.

"Final" status data may be used freely, bearing in mind the above comment that minor changes may still occur. The data should be referenced as European Environment Agency: CORINAIR 90 Summary Report no. 1, 1995. Some data on single large point sources are not published within these reports as some of these data are confidential in many countries.

It should be noted that the data reported here from CORINAIR90 are not fully consistent with those reported in line with the IPCC Guidelines for National Greenhouse Gas Inventories under the UN Framework Climate Change Convention or the EU Decision on a Monitoring Mechanism for CO_2 and other greenhouse gases. CORINAIR90 data have been used by several countries as a basis for such reporting but this requires careful

re-allocation and re-aggregation between reporting categories as highlighted in the IPCC Guidelines and some gaps and inconsistencies remain to be resolved between IPCC and the EEA.
It should also be noted that the data in CORINAIR 90 are not fully consistent with those in CORINAIR 85. For example the number of sources for NMVOC has been increased and emission factors for NO_x for traffic are not consistent for the two datasets. Therefore no comparisons have been made for SO_x, NO_x and NMVOC between the data for 1985 and 1990.

The results of CORINAIR 90 appear initially in a series of three reports to be published by the European Environment Agency in 1997.

This first report provides for each pollutant the summary of CORINAIR 90. For each pollutant it gives the contribution of individual countries to the total European emissions as well as emissions per main source group, per capita and per km^2 and the emissions for groups of countries (EU-12, EU-15, EFTA-5 and PHARE-10).

Further summary reports on CORINAIR 90 focus on the following items:

report 2	presentation and analysis by sub-group split
report 3	large point sources

These reports are being made available by the European Environment Agency for use by policy makers, researchers, convention secretariat and the general public.

The results of CORINAIR 90 provide the most detailed, complete, consistent and transparent European atmospheric emission inventory to date. However the results are estimates of actual emissions with significant uncertainties in some cases. Furthermore, some gaps and inconsistencies remain. Comments and observations on the results presented in this series of reports are welcome to assist in the short-term verification of CORINAIR 90 and the longer term development of the methodology.

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The following national experts made contributions to the CORINAIR 90 exercise:

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SUMMARY

Emissions of air pollutants in Europe in 1990

CORINAIR 90 produced an emission inventory for 30 EUROPEAN countries. The results for the 8 pollutants investigated are:

pollutant	emissions for EUROPE (1000 t)	
	with nature	without nature
SO_x as SO_2	28 054	27 480
NO_x as NO_2	18 006	17 956
NMVOC	21 770	17 422
CH_4	45 415	35 009
CO	69 712	68 354
CO_2	4 764 463	4 469 684
N_2O	1 880	1 327
NH_3	5 701	5 586

Major contributors

The EU-12 countries accounted for between 44% (SO_x) and 69% (NMVOC) of total EUROPEAN emissions, the PHARE-10 countries for between 16% (NMVOC) and 38% (SO_x) of total emissions and the EFTA-5 countries for between 2% (SO_x) and 11% (NMVOC).

In 1990 the countries making the largest contribution to the total emissions of each pollutant were

- Germany (former East) SO_x
- United Kingdom NO_x
- France NMVOC, NH_3, CO, N_2O
- Germany (former West) CO_2
- Poland CH4.

For all pollutants the differences in national emissions are due to differing population sizes and differences in per capita emissions. Natural emissions of NMVOC, NH_3, N_2O and CH_4 are also significant for some countries.

Emissions per capita

For EUROPE the following per capita emissions (in kg/capita) were estimated for the year 1990:

pollutant	per capita emissions (kg/capita)
SO_x	57
NO_x	37
NMVOC	36
CH_4	72
CO	141
CO_2	9 216
N_2O	3
NH_3	12

Emissions from natural sources (group 11) have been excluded from this per capita calculation since (most of) the natural source groups are not related to human activities.

In comparison with the average per capita emissions for EUROPE, per capita emissions of SO_x, NO_x, N_2O, CO_2 and NH_3 were lower in the EFTA-5 countries (between 72% for SO_x and 17% for NH_3). Per capita emissions of NMVOC were lowest in the PHARE-10 group of countries (31%), and the EU-12 countries had the lowest per capita emissions of CO (3% below the average for EUROPE).
In 1990 the countries with the largest and smallest per capita emissions for the different pollutants were

	largest	smallest
SO_x	Germany (former East)	Switzerland
NO_x	Czech Republic	Hungary
NMVOC	Norway	Malta
CH_4	Ireland	Portugal
CO	Luxembourg	Slovenia
CO_2	Luxembourg	Portugal
N_2O	Ireland	Malta
NH_3	Greece	Hungary

The smallest and largest per capita emissions differed between a factor of between 37 (SO_x) and 4 (NO_x). Special reports for each pollutant to be published later in 1995 will

analyse these (large) differences and examine whether they are due to differences in emission factors or differences in activities. These reports will also explain differences in emission factors.

Emissions per km^2

For EUROPE the following emissions (in kg per km^2) were estimated for the year 1990:

pollutant	emissions (kg/km^2)
SO_x	5 931
NO_x	3 807
NMVOC	4 603
CH_4	9 602
CO	14 739
CO_2	1 007 406
N_2O	397
NH_3	1 205

In comparison to the average levels estimated for EUROPE emissions per km^2 of all pollutants were smallest in the EFTA-5 countries (between 93% for SO_x and 58% for NMVOC). Emissions per km^2 were largest in the EU-12 group of countries (between plus 42% for NO_x and 25% for CH_4) with the exception of SO_x, for which levels were highest for the PHARE-10 group of countries (69% above the EUROPEAN average).

In 1990 the countries with the largest and smallest emissions per km^2 for the pollutants investigated were

	largest	smallest
SO_x	Germany (former East)	Norway
NO_X	Malta	Norway
NMVOC	Belgium (Flemish region)	Norway
CH_4	Greece	Norway
CO	Malta	Finland
CO_2	Malta	Norway
N_2O	Greece	Norway
NH_3	Malta	Norway

The smallest and the largest emissions per km^2 differed by a factor of between 243 (SO_x) and 20 (NMVOC). In general the differences between the emissions per km^2 are much larger than the differences in the emissions per capita. It is obvious that the predominant reason for the low emissions per km^2 in the Scandinavian countries is their low population density.

Special reports to be published later in 1995 will analyse these (large) differences in more detail.

Largest contributing source groups

Emissions are split into the following source groups in this report:

group	group name
1	Public power, cogeneration and district heating
2	Commercial, institutional and residential combustion
3	Industrial combustion
4	Production processes
5	Extraction and distribution of fossil fuels
6	Solvent use
7	Road transport
8	Other mobile sources and machinery
9	Waste treatment and disposal
10	Agriculture
11	Nature

The following source groups made the largest contribution to total emissions in EUROPE in 1990:

pollutant	group	contribution (%)
SO_x	1	54
NO_x	7	44
NMVOC	7	31
NH_3	10	92
CO	7	56
CH_4	10	33
N_2O	10	39
CO_2	1	28

For each pollutant the table also shows the percentage contribution of the source group to total emissions. The only pollutant where a single source group (agriculture) dominates emissions almost exclusively is NH_3. However, in the case of CO and $SO_{x,}$ more than 50% of the total emissions can be attributed to one source group - road transport for CO, and public power, cogeneration and district heating for SO_x.

The next table shows the number of countries in which a source group was the largest contributor to emissions of a pollutant. The table also gives the range of the source groups contribution in all countries.

pollutant	group	number of countries	range of contribution (%)
SO_x	1	19	79 - 0
	3	8	87 - 3
	4	2	57 - 0
	2	1	33 - 2
	8	1	49 - 0
NO_x	7	20	68 - 9
	8	5	50 - 1
	1	4	42 - 0.4
	3	2	47 - 0.4
NMVOC	7	14	59 - 10
	11	10	68 - 0
	6	4	47 - 1
	5	1	41 - 0
	10	1	40 - 0
CH_4	10	15	76 - 7
	11	6	83 - 0
	5	6	56 - 0
	9	3	80 - 0
CO	7	23	91 - 14
	2	4	48 - 0.4
	3	2	57 - 0
	9	1	42 - 0
CO_2	1	18	65 - 1
	3	9	58 - 2
	2	2	39 - 2
	11	1	50 - 0
N_2O	10	20	88 - 6
	11	6	88 - 0
	4	4	53 - 0
NH_3	10	30	100 - 60

This overview shows that for all pollutants with the exception of NH_3 the individual source groups may contribute very differently to emissions in different countries.

However, it is evident already from this overview that (with the possible exception of NH_3), strategies for reducing emissions of pollutants in EUROPEAN countries need solutions which are specific to individual countries, as well as common elements.

1. SULFUR OXIDES - SO_x

1.1 SO_x-emissions by countries

The 1990 annual total SO_x-emissions for EUROPE were estimated to be 28 million tonnes as SO_x. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 1.1. The largest contributor were the EU-12 countries with 44%, second largest the PHARE-10 countries with 38%; Germany (former East), Croatia and Malta contributed 16% and the EFTA-5 countries 2%.

Figure 1.1: Contribution in % to the EUROPEAN total SO_x-emissions

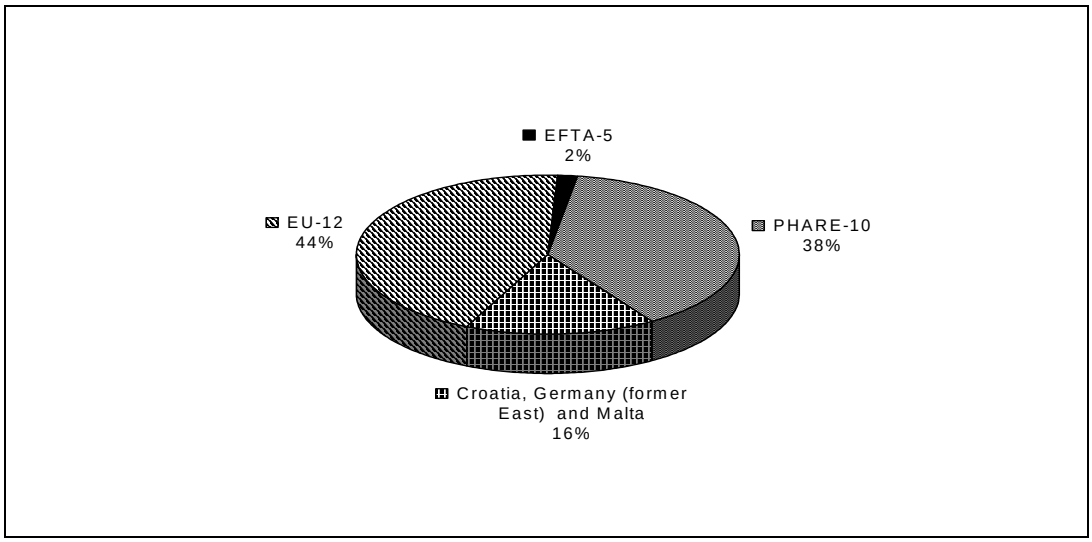
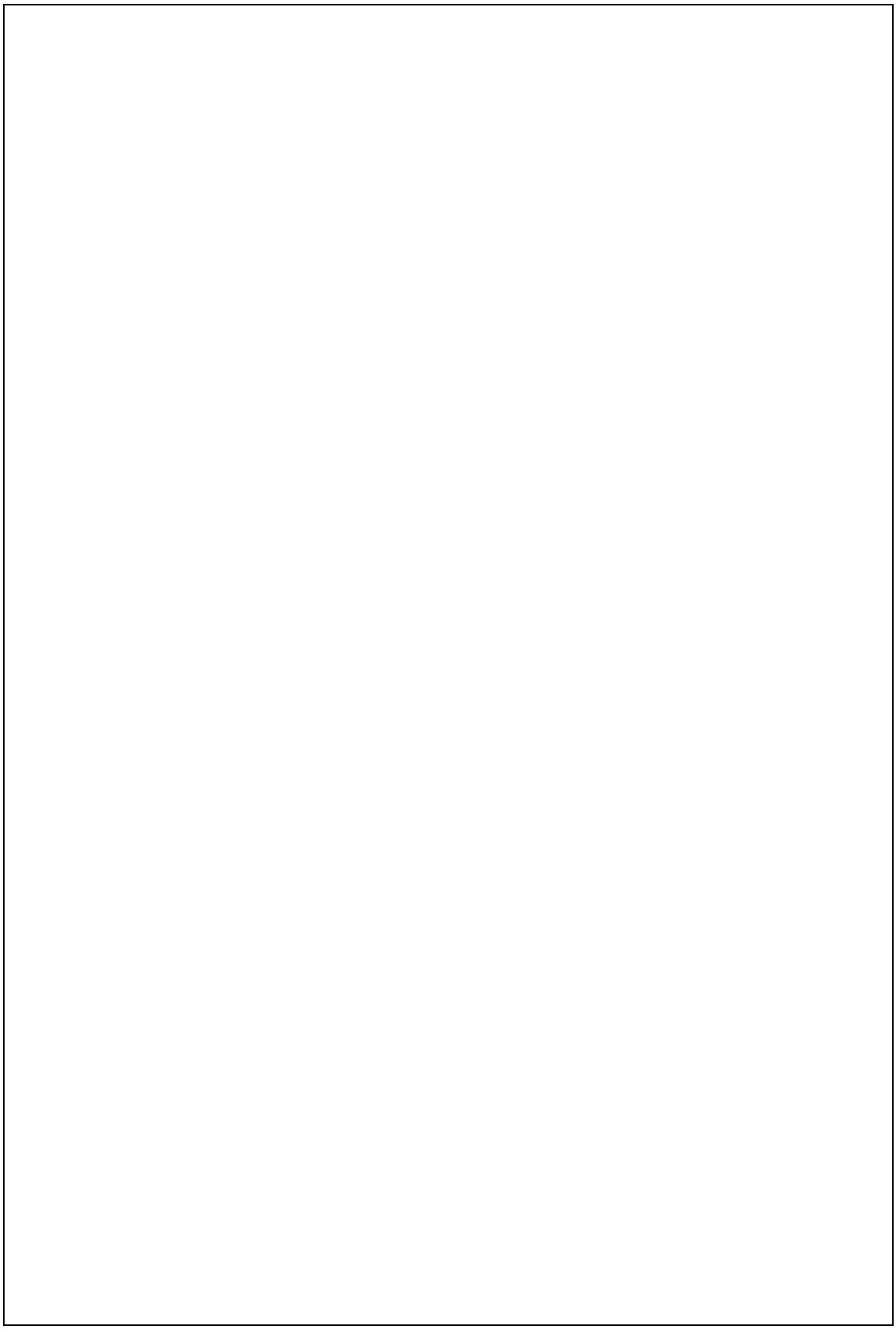


Figure 1.2 shows the relative contribution of individual countries to the total of 28 million tonnes. In 1990 the largest contributing countries were Germany (former East; 15%), the United Kingdom (14%), Poland (12%) and Italy (8%); the smallest contributing countries were Malta (0.02%), Luxembourg (0.05%), Switzerland (0.16%) and Austria (0.3%). These differences are due to different size of population, different per capita emissions (see also paragraph 1.3) and differences in emissions from natural sources. Different per capita emissions are due to different types of human activities and differences in air pollution control measures.

Figure 1.2: Contribution in % of each country to the EUROPEAN total SO_x-emissions



1.2 SO_x-emissions per group

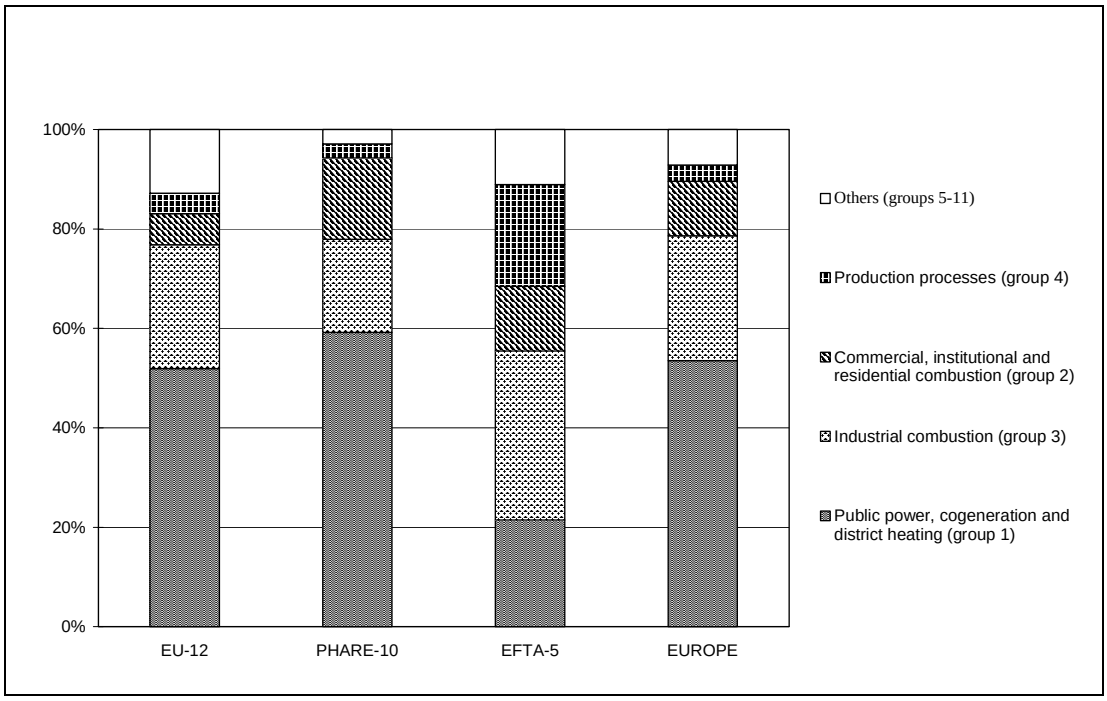
Ninety percent of the SO_x-emissions for EUROPE in 1990 resulted from emissions of group 1 (public power, cogeneration and district heating), group 2 (commercial, institutional and residential combustion) and group 3 (industrial combustion). Group 1 contributed the largest share with 54%, group 3 and group 2 were the groups with the next largest contribution almost exclusively of 25% and 11%. The remaining 10% of the total emissions can be attributed almost exclusively to emissions of the groups 4 (production processes), 7 (road transport), 8 (other mobile sources and machinery) and 11 (nature).

The split of the SO_x-emissions into groups for EU-12 and PHARE-10 countries is quite similar compared to the split for EUROPE with the exception of the relative large contribution from group 11 (nature) for EU-12 countries which is due to the emissions of volcanoes, mainly in Italy. The split into groups for EFTA-5 countries is different from that already described split for EUROPE (see figure 1.3). The largest contribution from the EFTA-5 countries is group 3 (industrial combustion) with 34%, the second largest group is group 1 (public power, cogeneration and district heating) with 21% followed by group 4 (production processes) with 20%.

The differences of contributions of the main source groups 1, 2 and 3 to the total emissions are larger between countries than these groups (see also table 1.1). The contribution of group 1 in the countries ranges from 79% (Slovenia and Estonia) to 1% (Luxembourg), contribution of group 2 SO_x-emissions ranges from 33% (Switzerland) to 2% (Netherlands, Portugal, Estonia) and contribution of group 3 SO_x-emissions ranges from 87% (Luxembourg) to 3% (Latvia).

However it is evident from these differences in the relative contribution of source groups to a countries total emissions that strategies for reduction of SO_x-emission need individual solutions as well as common elements.

Figure 1.3: Contribution in % of source groups to the EUROPEAN SOx-emissions



1.3 SO_x-emissions per capita

Only anthropogenic emissions are expected to be related to population for these calculations. Therefore group 11 (nature) has been excluded.

For EUROPE the average SO_x-emissions per capita were 57 kg/capita. Compared to this number the per capita SO_x-emissions were 77% larger for the PHARE-10 countries with 101 kg/capita, 37% smaller for the EU-12 countries with 36 kg/capita and 72% smaller for the EFTA-5 countries with 16 kg/capita. This comparison is also shown in figure 1.4 and table 9.

Again the differences are much larger if individual countries are compared; the largest SO_x-emissions per capita were estimated for Germany (former East; 261 kg/capita) and the next largest ones for Bulgaria (223 kg/capita) and Czech Republic (181 kg/capita); the smallest per capita emissions for SO_x were calculated for Switzerland (7 kg/capita), Sweden and Austria (each 12 kg/capita), Norway (13 kg/capita), the Netherlands (14 kg/capita) and Germany (former West; 15 kg/capita). Figure 1.5 shows the countries ranked according their per capita emissions. The already mentioned special report for

SO_x will analyse these large differences of the per capita emissions for SO_x, the smallest per capita emissions being a factor of 37 smaller compared to the largest number.

Figure 1.4: SO_x-emissions per capita for EUROPE

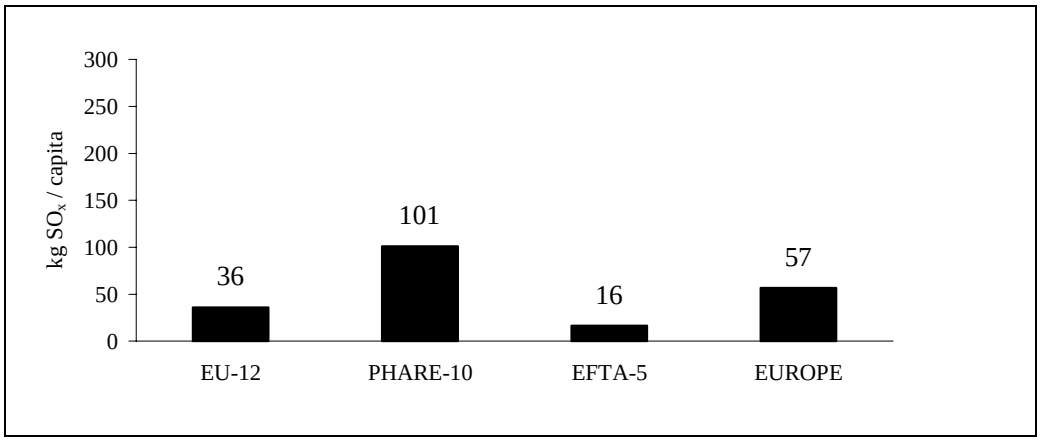
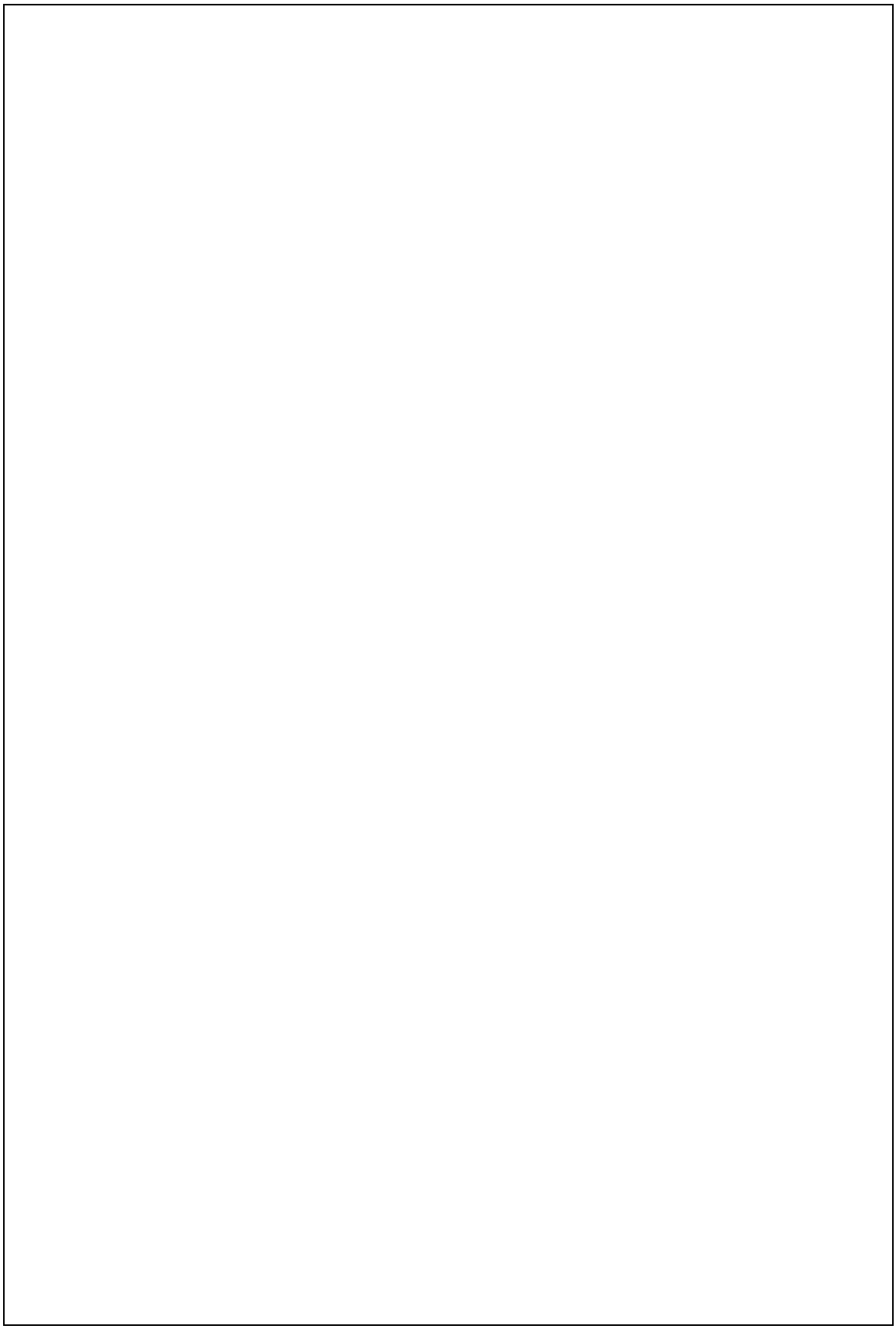


Figure 1.5: SO_x-emissions per capita for individual countries

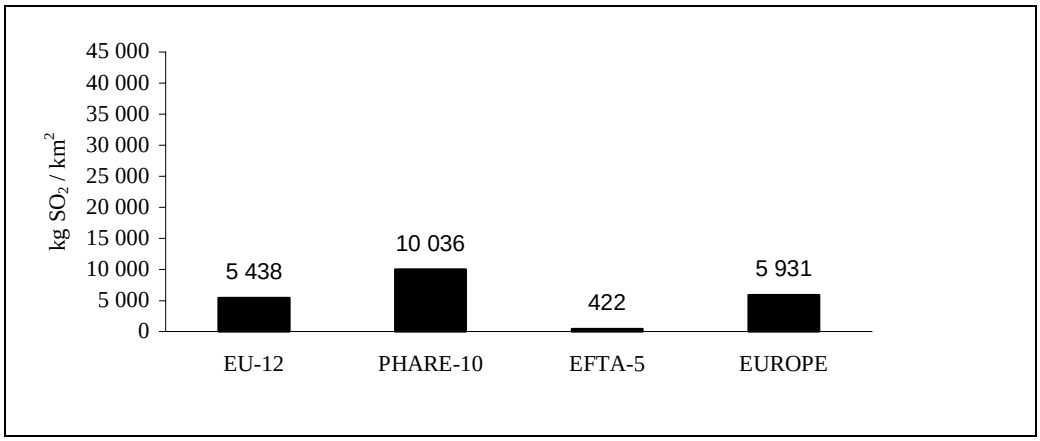


1.4 SO_x-emissions per km^2

The emissions per km^2 have been calculated from the total emissions, the emissions of group 11 (nature) having been included in this case.

For EUROPE the average SO_x-emissions per km^2 were estimated as 5 931 kg/km^2. Compared to this number the per km^2 SO_x-emissions were 69% larger for the PHARE-10 countries with 10 036 kg/km^2, 8% smaller for the EU-12 countries with 5 438 kg/km^2 and 93% smaller for the EFTA-5 countries with 422 kg/km^2. This comparison is also shown in figure 1.6 and table 10.

Figure 1.6: SO_x-emissions per km^2 for EUROPE



Again the differences are much larger if individual countries are compared; the largest SO_x-emissions per km^2 were for Germany (former East; 40 088 kg/km^2) and the next largest ones for Czech Republic (23 618 kg/km^2), Malta (19 199 kg/km^2) Bulgaria (18 106 kg/km^2) and Belgium, Flemish region (15 829 kg/km^2); the smallest emissions per km^2 for SO_x were for Norway (165 kg/km^2), Sweden (233 kg/km^2), Finland (671 kg/km^2) and Switzerland (1 068 kg/km^2). Figure 1.7 shows the countries ranked according their SO_x-emission per km^2. The differences in the emissions per km^2 between countries are much larger compared to the differences of the per capita emissions. The smallest number being 243 times smaller than the largest number.

Figure 1.7: SO_x-emissions per km^2 for individual countries

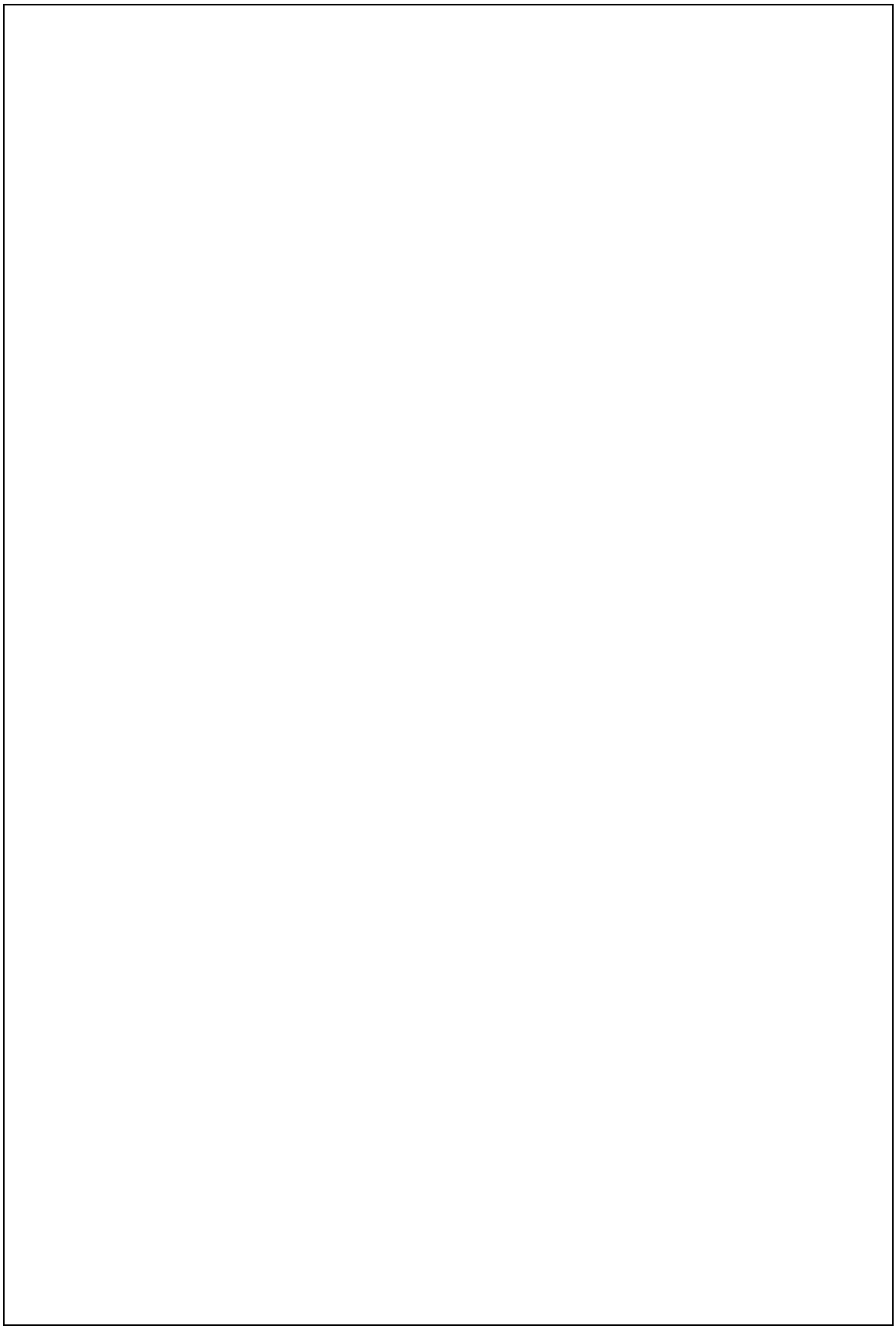


Table 1.1: Sulfur oxides emissions per country and group

2. NITROGEN OXIDES - NO_x

2.1 NO_x-emissions by countries

The 1990 annual total NO_x-emissions for EUROPE were estimated to be 18 million tonnes as NO_2. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 2.1. The largest contributor were the EU-12 countries with 67%, second largest the PHARE-10 countries with 22%; the EFTA-5 countries contributed 7% and Germany (former East), Croatia and Malta 4%.

Figure 2.1: Contribution in % to the European total NO_x-emissions

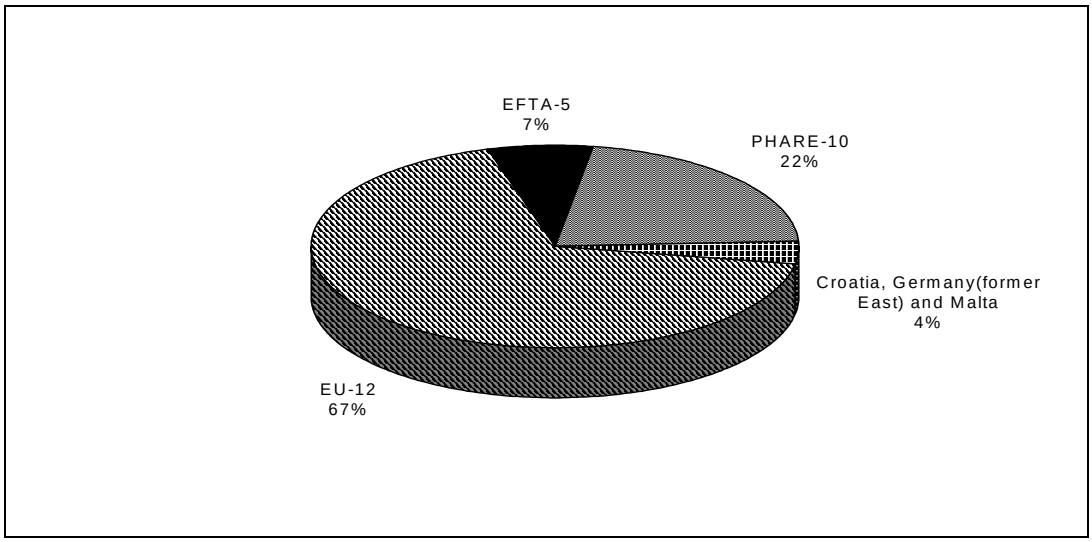
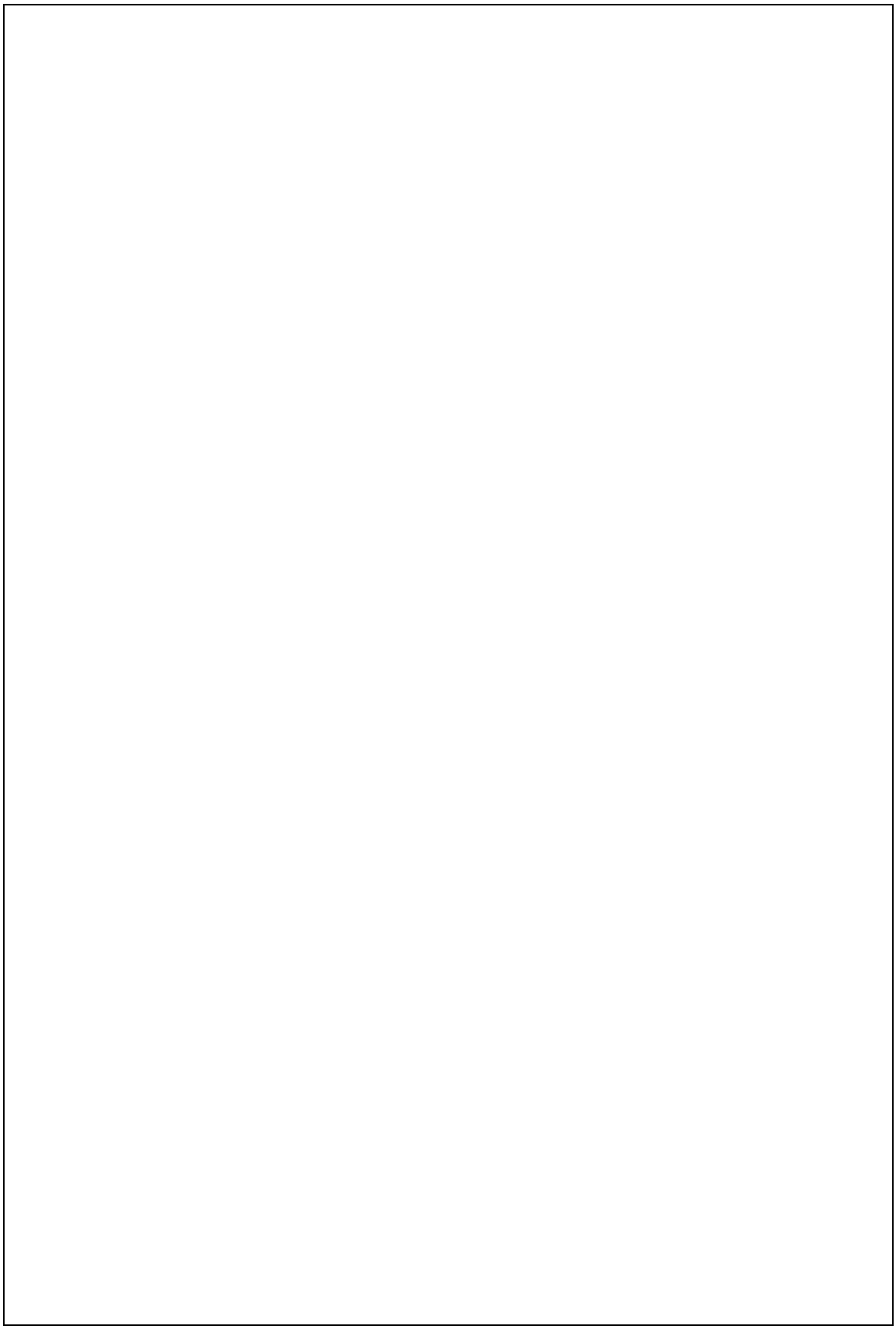


Figure 2.2 shows the relative contribution of individual countries to the total of 18 million tonnes. In 1990 the largest contributing countries were the United Kingdom (15%), Germany (former West; 13%) and Italy (11%); the smallest contributing countries were Malta (0.06%), Luxembourg (0.1%), Slovenia (0.3%) and Estonia (0.4%). These differences are due to different size of population and different per capita emissions (see also paragraph 2.3).

Figure 2.2: Contribution in % of each country to the EUROPEAN total NOx-emissions



2.2 NO_x-emissions per group

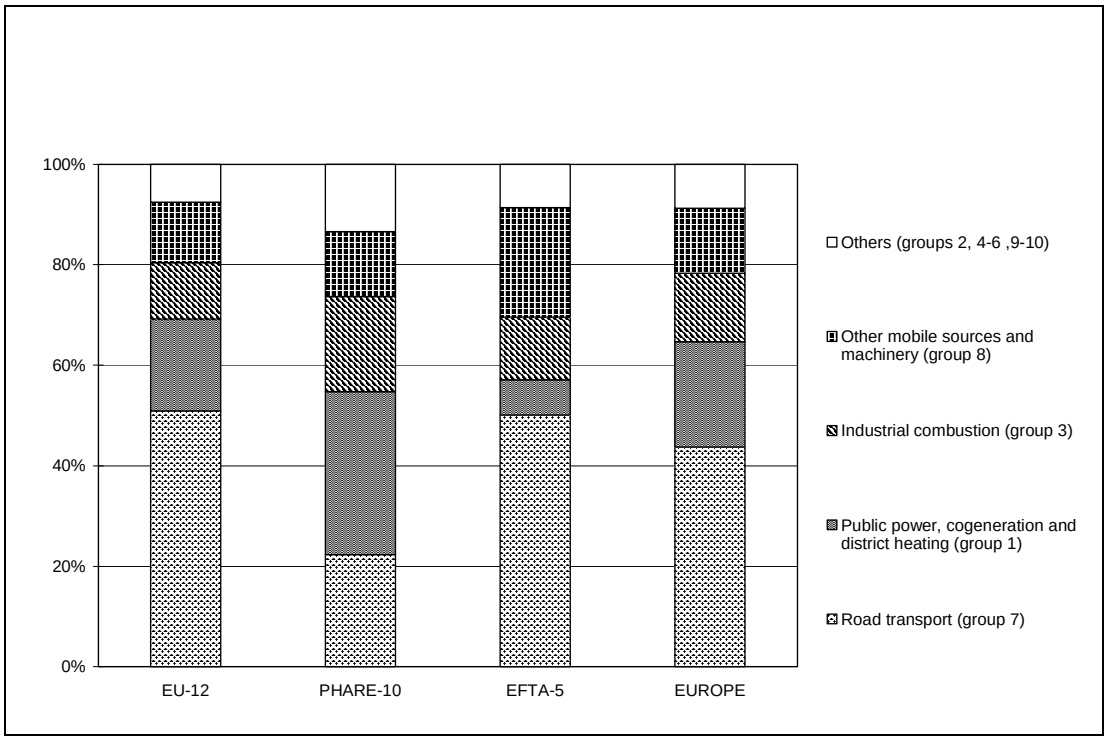
More than fifty percent of the NO_x-emissions for EUROPE in 1990 were produced by road transport (group 7) and other mobile sources and machinery (group 8). Forty percent of the NO_x-emissions for EUROPE resulted from emissions of group 1 (public power, cogeneration and district heating), group 2 (commercial, institutional and residential combustion) and group 3 (industrial combustion) together. Group 7 contributed the largest share with 44%, groups 1, 3 and 8 were the groups with the next largest contribution of 21, 14 and 13%. The remaining 8% of the total emissions can be attributed to emissions of the group 2 (commercial, institutional and residential combustion), group 4 (production processes) and group 9 (waste treatment and disposal).

The split of the NO_x-emissions into groups for EU-12, EFTA-5 and PHARE-10 countries is quite similar compared to the split for EUROPE with the exception of the relative large contribution of group 1 with 32% and a relative small contribution of group 7 with 22% for the PHARE-10 countries and a larger contribution of group 8 with 22% for the EFTA-5 countries (see figure 2.3).

The differences of contributions of the main source groups 7, 1, 3, and 8 to the total emissions are larger between countries than these groups (see also table 2.1). The contribution of group 7 in the countries ranges from 68% (Austria) to 9% (Romania), of group 1 from 42% (Czech Republic) to 0.4% (Norway), group 3 from 47% (Luxembourg) to nearly 0.4% (Greece) and group 8 from 50% (Norway) to 2% (Belgium, Wallonie region).

It is intended to explain these significant differences in a special NO_x-report. However it is evident from these differences in the relative contribution of source groups to a countries total emissions that strategies for reduction of NO_x-emission will need individual solutions as well as common elements.

Figure 2.3: Contribution in % of source groups to the European NO_x-emissions



2.3 NO_x-emissions per capita

Only anthropogenic emissions are expected to be related to population for these calculations. Therefore group 11 (nature) has been excluded.

For EUROPE the average NO_x-emissions per capita were 37 kg/capita. Compared to this number the per capita NO_x-emissions were only little larger for the EFTA-5 countries with 39 kg/capita, equal for the EU-12 and PHARE-10 countries with 37 kg/capita. This comparison is also shown in figure 2.4 and table 9.

Again the differences are much larger if individual countries are compared; the largest NO_x-emissions per capita were estimated for the Czech Republic (75 kg/capita) and the next largest ones for Luxembourg (61 kg/capita), Norway (55 kg/capita) and Finland and Greece (each 54 kg/capita); the smallest per capita emissions for NO_x were calculated for Hungary (18 kg/capita), Portugal and Croatia each (21 kg/capita), Romania (24 kg/capita) and Switzerland (25 kg/capita). Figure 2.5 shows the countries ranked according their per capita emissions. The already mentioned special report for

NO_x will analyse these differences in the per capita emissions for NO_x, the smallest per capita emissions being almost a factor of 4 smaller compared to the largest number.

Figure 2.4: NO_x-emissions per capita for EUROPE

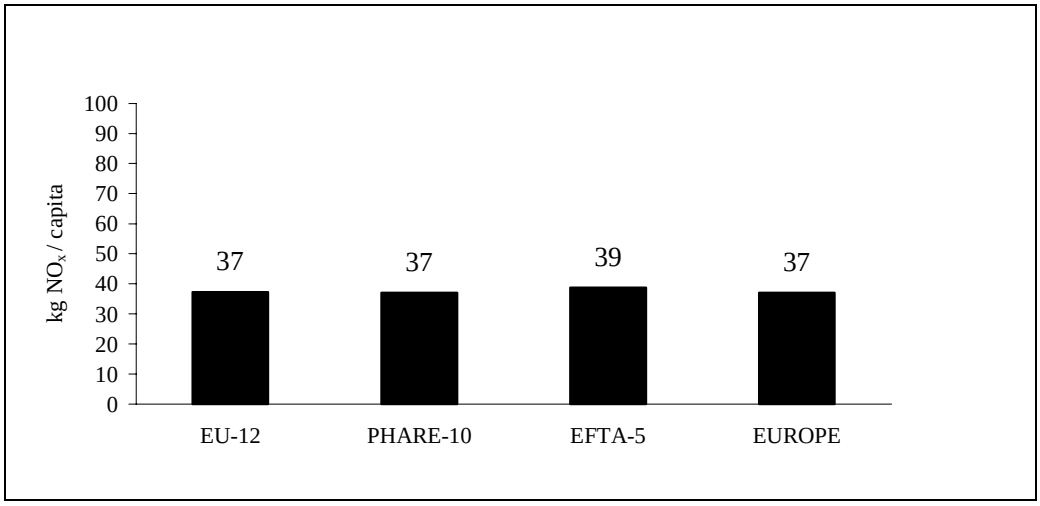
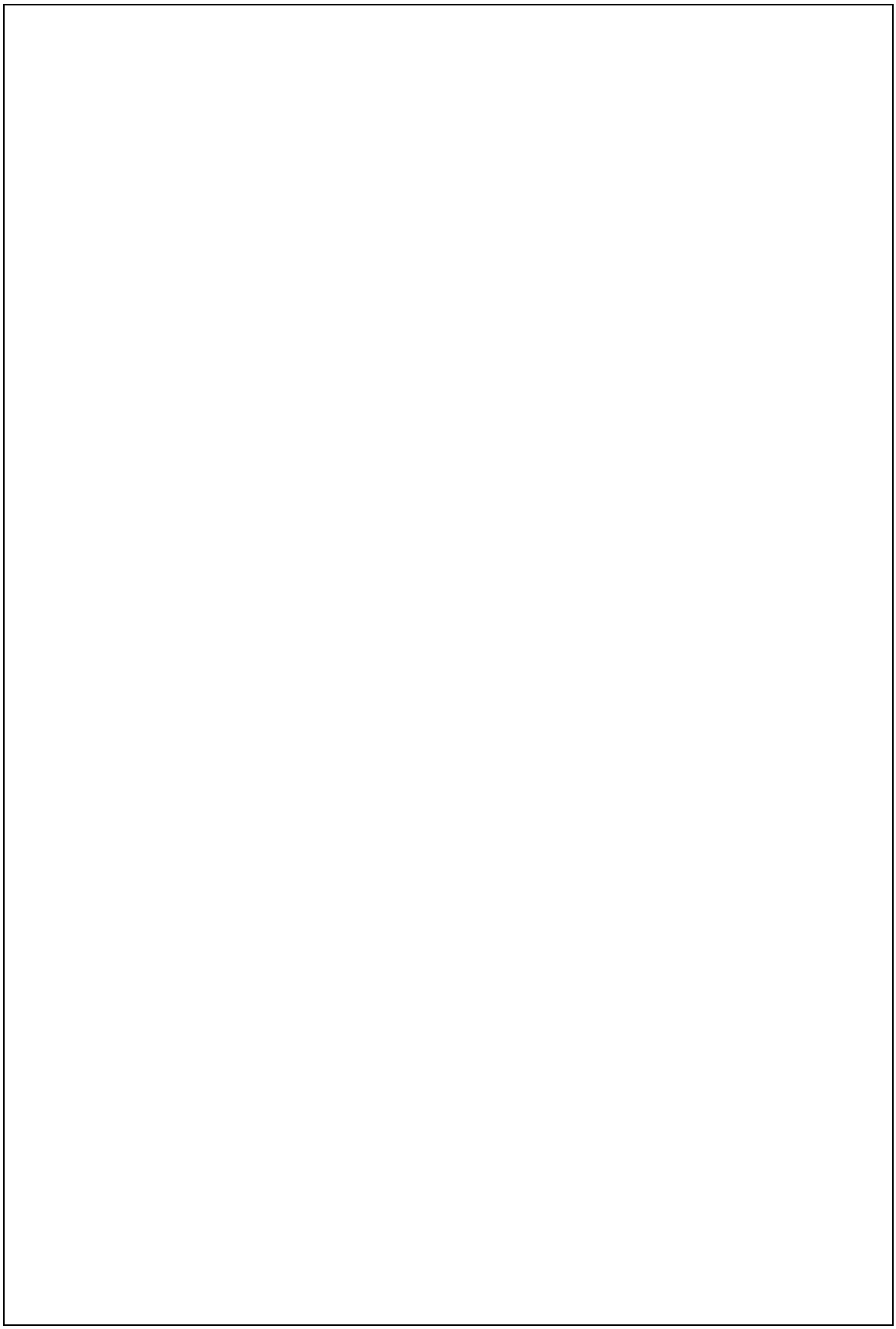


Figure 2.5: NO_x-emissions per capita for individual countries

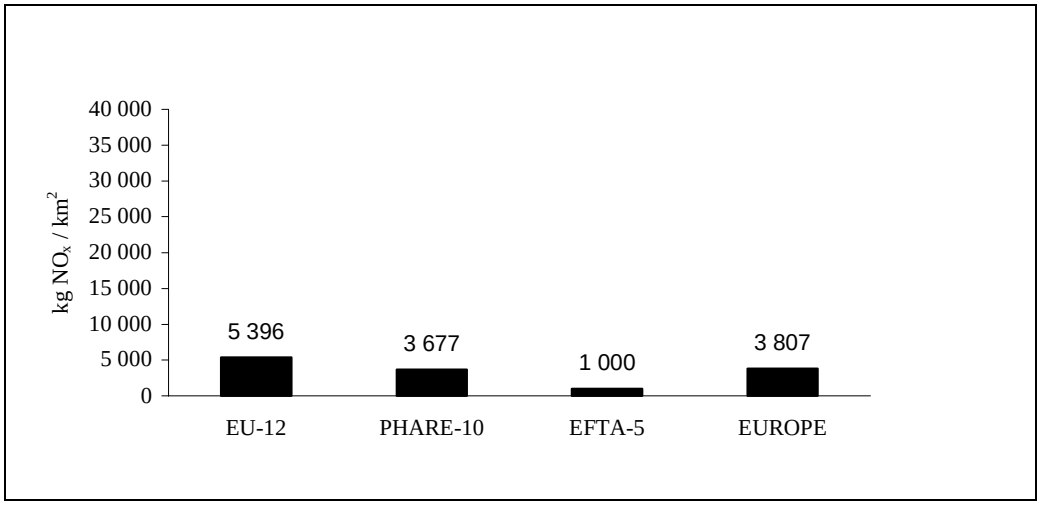


2.4 NO_x-emissions per km^2

The emissions per km^2 have been calculated from the total emissions, the emissions of group 11 (nature) having been included in this case.

For EUROPE the average NO_x-emissions per km^2 were estimated as 3 807 kg/km^2. Compared to this number the per km^2 NO_x-emissions were 3% smaller for the PHARE-10 countries with 3 677 kg/km^2, 42% larger for the EU-12 countries with 5 396 kg/km^2 and 74% smaller for the EFTA-5 countries with 1 000 kg/km^2. This comparison is also shown in figure 2.6 and table 10**.**

Figure 2.6: NO_x-emissions per km^2 for EUROPE



Again the differences are much larger if individual countries are compared: the largest NO_x-emissions per km^2 were for the Malta (36 614 kg/km^2) and the next largest ones for Netherlands (13 887 kg/km^2) and Belgium, Flemish region (13 439 kg/km^2); the smallest emissions per km^2 for NO_x were for Norway (717 kg/km^2), Sweden (767 kg/km^2) and Finland (794 kg/km^2). Figure 2.7 shows the countries ranked according their NO_x-emission per km^2. The differences in the emissions per km^2 between countries are much larger compared to the per capita emissions. The smallest number being 51 times smaller than the largest number.

Figure 2.7: NO_x-emissions per km^2 for individual countries

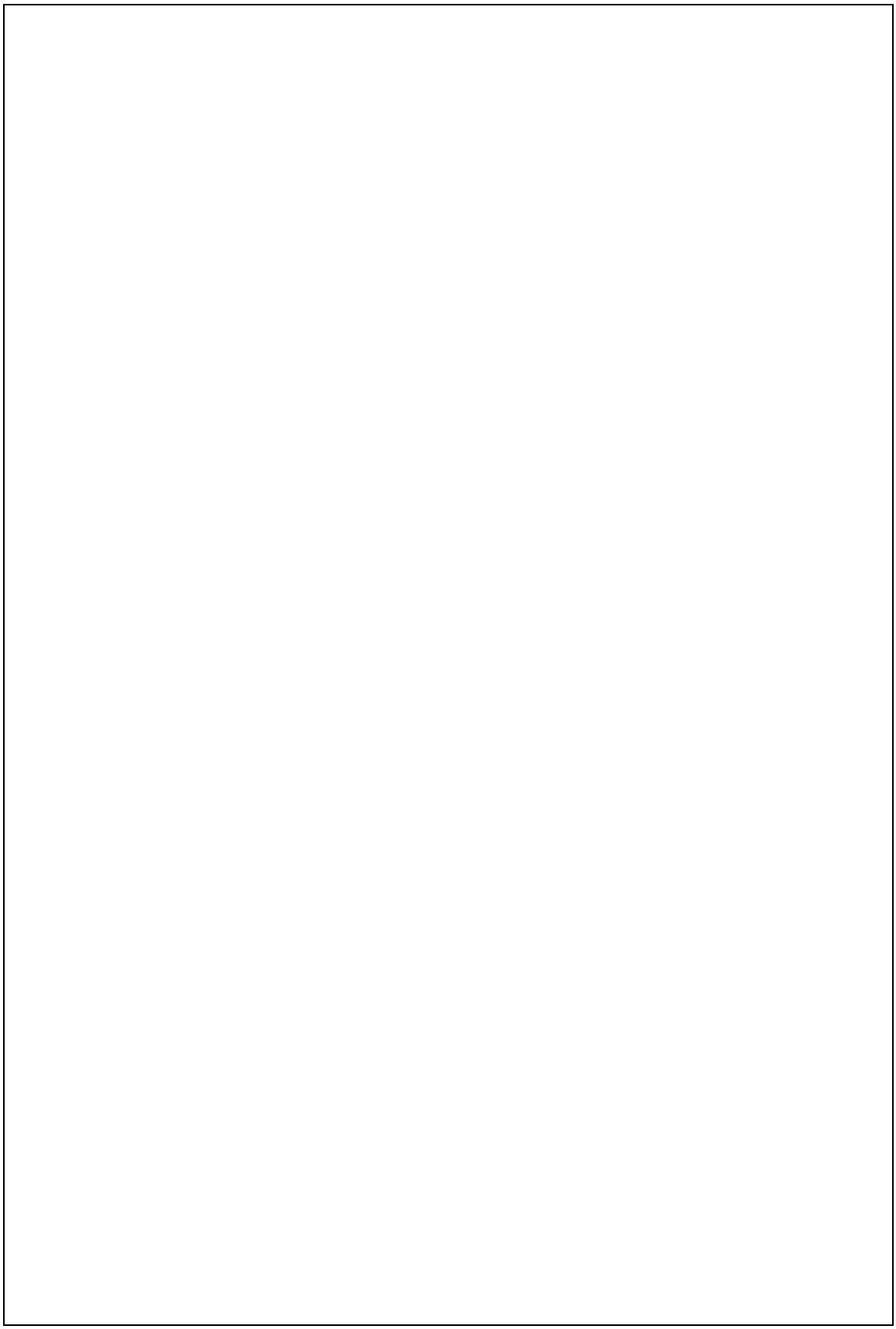


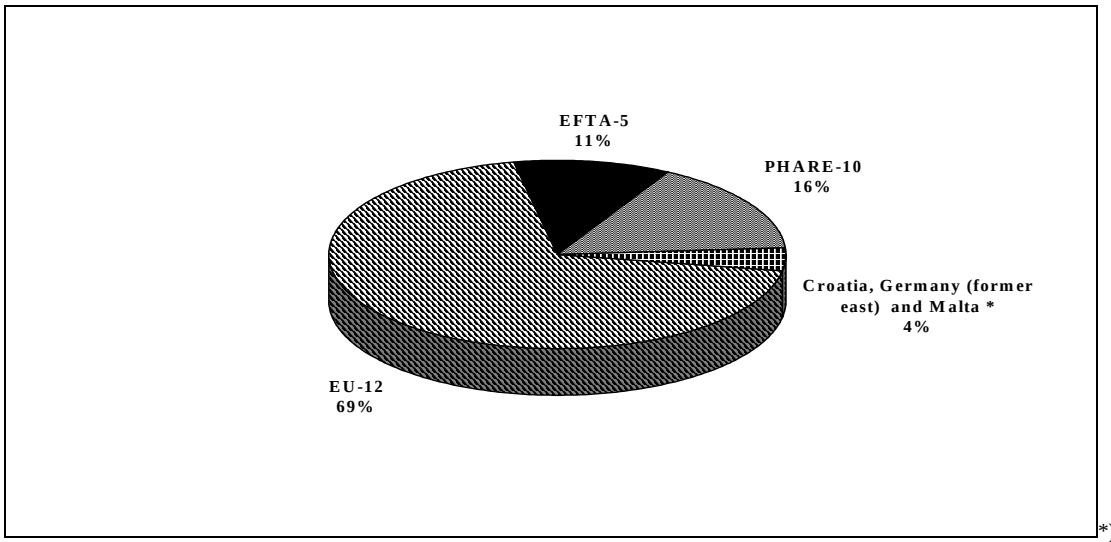
Table 2.1: Nitrogen oxides emissions per country and group

3. NON-METHANE VOLATILE ORGANIC COMPOUNDS - NMVOC

3.1 NMVOC-emissions by countries

The 1990 annual total NMVOC-emissions for EUROPE were estimated to be 22 million tonnes. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 3.1. The largest contributor were the EU-12 countries with 69%, second largest the PHARE-10 countries with 16%. The EFTA-5 countries contributed 11% and Germany (former East) and Malta 4%.

Figure 3.1: Contribution in % to the EUROPEAN total NMVOC-emissions



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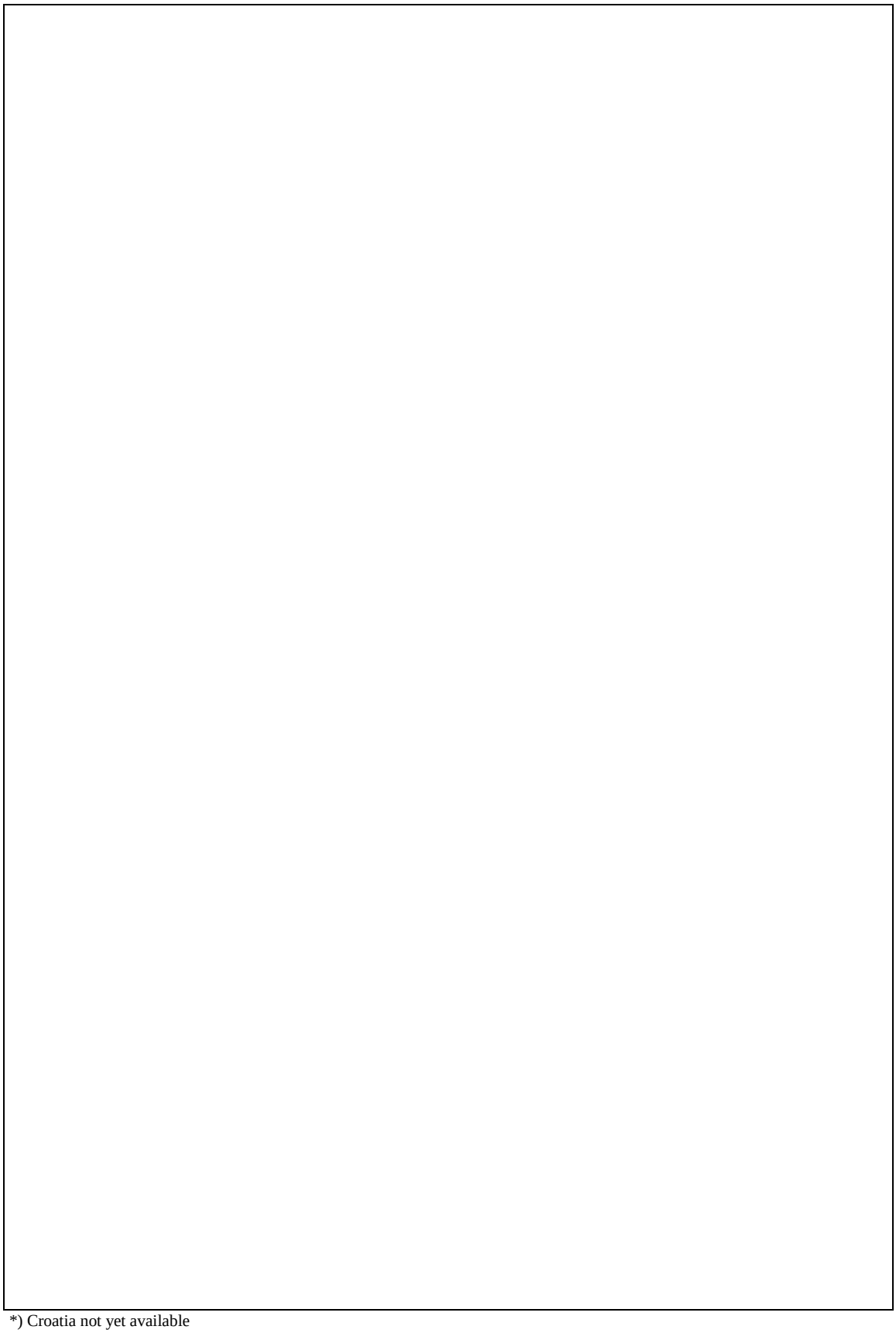
Croatia not yet available

Figure 3.2 shows the relative contribution of individual countries to the total of 20 million tonnes. In 1990 the largest contributing countries were France (13%), United Kingdom (12%), Germany (former West 11%) and Italy (12%); the smallest contributing countries were Malta (0.02%), Luxembourg (0.09%) and Slovenia (0.2%). These differences are due to different size of population, different per capita emissions (see also paragraph 3.3) and differences in emissions from natural sources.

Figure 3.2: Contribution in % of each country to the EUROPEAN total NMVOC-emissions



*) Croatia not yet available

3.2 NMVOC-emissions per group

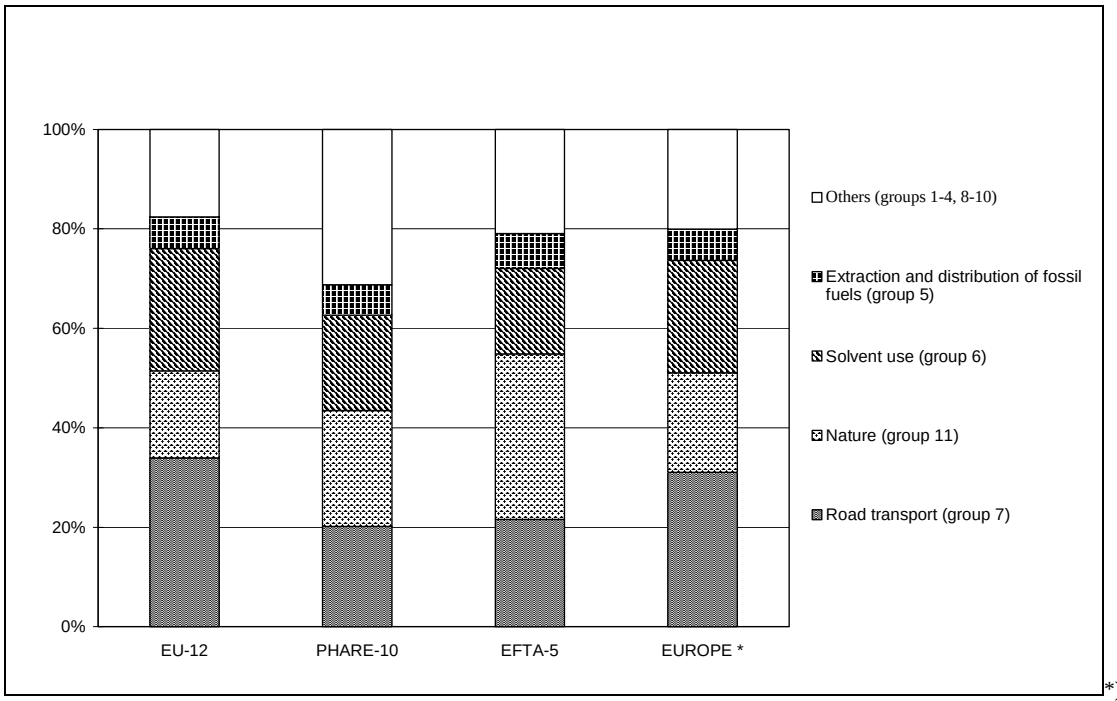
One third of the NMVOC-emissions for EUROPE resulted from emissions of group 7 (road transport) and from group 8 (other mobile sources and machinery). Group 6 (solvent use) and group 11 (nature) each contributed about 20% and group 4 (production processes) and group 5 (extraction and distribution of fossil fuels) each contributed 6%. In contrast to other pollutants group 1 (public power, cogeneration and district heating), 2 (commercial, institutional and residential combustion) and 3 (industrial combustion) together produced little of the NMVOC-emissions with only 6%. The remaining 5% of the total emissions can be attributed almost exclusively to emissions of the groups 9 (waste treatment and disposal) and 10 (agriculture).

The split of the NMVOC-emissions into groups for EU-12, EFTA-5 and PHARE-10 countries is quite similar compared to the split for EUROPE with the exception of the larger contribution of group 2 (commercial, institutional and residential combustion) with 10% and of group 11 (nature) with 33% to the total NMVOC-emissions for the EFTA-5 countries (see figure 3.3).

The differences of contributions especially of source groups 2, 6, 7 and 11 to the total emissions are larger between countries than these groups (see also table 3.1). The relative contribution of the NMVOC-emissions of group 2 ranges from 20% (Czech Republic) to 0% (Finland, Greece, Malta, Luxembourg), of group 7 from 59% (Malta) to 10% (Romania), of group 6 (solvent use) from 47% (Switzerland) to 1% (Latvia), and of group 11 from 68% (Portugal) to 0% (Estonia, Hungary, Malta, Norway, Slovenia, Switzerland).

However it is evident from these differences in the relative contribution of sourcegroups to a countries total emission that strategies for reduction of NMVOC-emissions need individual solutions as well as common elements.

Figure 3.3: Contribution in % of source groups to the EUROPEAN NMVOC-emissions



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Croatia not yet available

3.3 NMVOC-emissions per capita

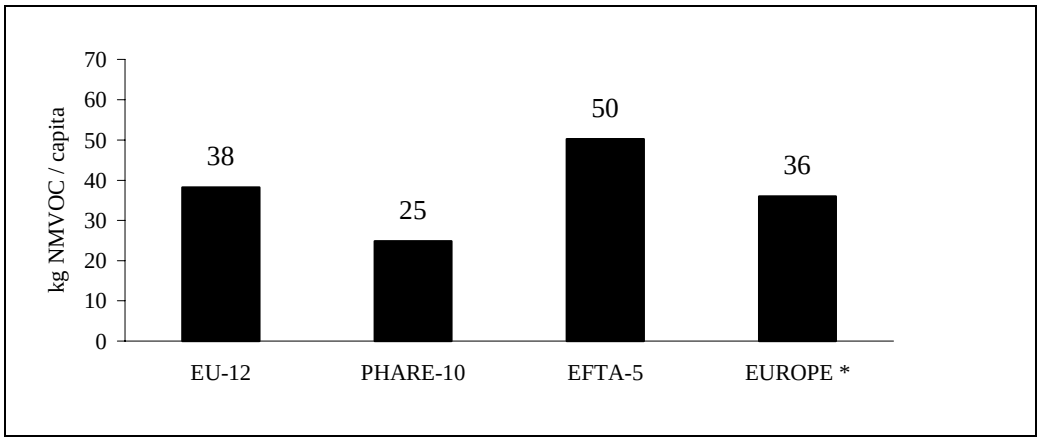
Only anthropogenic emissions are expected to be related to population for these calculations. Therefore group 11 (nature) has been excluded.

For EUROPE the average NMVOC-emissions per capita were as 36 kg/capita. Compared to this number the per capita NMVOC-emissions were almost equal (+6%) for the EU-12 countries with 38 kg/capita, 39% larger for the EFTA-5 countries with 50 kg/capita and 31% smaller for the PHARE-10 countries with 25 kg/capita. This comparison is also shown in figure 3.4 and table 9.

Again the differences are much larger if individual countries are compared; the largest NMVOC-emissions per capita were estimated for Norway (64 kg/capita) and the next largest ones for Austria (55 kg/capita) and Sweden (53 kg/capita); the smallest per capita emissions for NMVOC were calculated for Malta (13 kg/capita), Hungary (14 kg/capita), Slovenia and Latvia (each 18 kg/capita) and Portugal (20 kg/capita). Figure 3.5 shows the countries ranked according their per capita emissions. The already

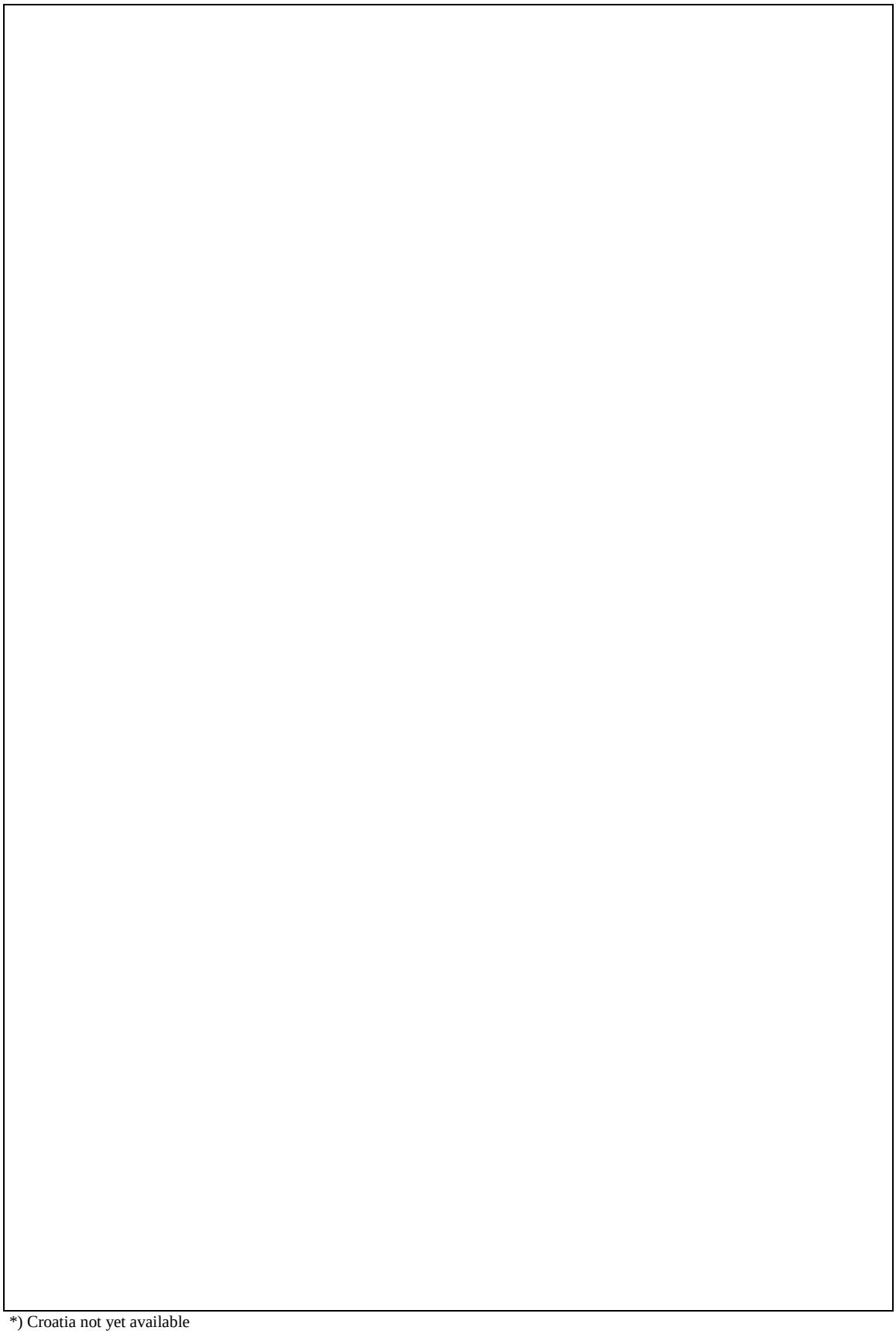
mentioned special report for NMVOC will analyse these large differences in the per capita emissions for NMVOC; the smallest per capita emissions being a factor of 5 smaller compared to the largest number.

Figure 3.4: NMVOC-emissions per capita for EUROPE



*) Croatia not yet available

Figure 3.5: NMVOC-emissions per capita for individual countries



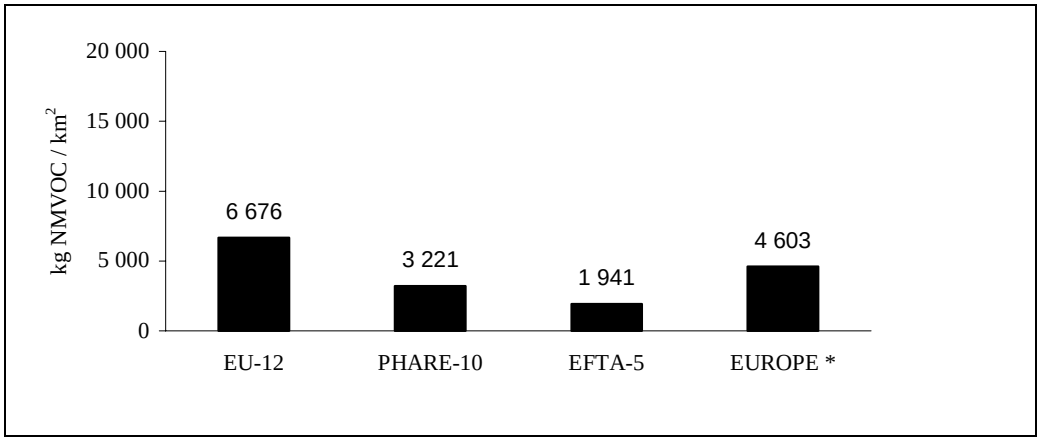
*) Croatia not yet available

3.4 NMVOC-emissions per km^2

The emissions per km^2 have been calculated from the total emissions, the emissions of group 11 (nature) having been included in this case.

For EUROPE the average NMVOC-emissions per km^2 were estimated as 4 603 kg/km^2. Compared to this number the per km^2 NMVOC-emissions were 45% larger for the EU-12 countries with 6 676 kg/km^2, 30% smaller for the PHARE-10 countries with 3 221 kg/km^2 and 58% smaller for the EFTA-5 countries with 1 941 kg/km^2. This comparison is also shown in figure 3.6 and table 10.

Figure 3.6: NMVOC-emissions per km^2 for EUROPE



*) Croatia not yet available

Again the differences are much larger if individual countries are compared; the largest NMVOC-emissions per km^2 were for Belgium, Flemish region (16 871 kg/km^2), Malta (14 101 kg/km^2) and the next largest ones for the Netherlands (11 094 kg/km^2) and the United Kingdom (10 986 kg/km^2); the smallest emissions per km^2 for NMVOC were for Norway (833 kg/km^2), Finland (1 353 kg/km^2) and Latvia (1 549 kg/km^2). Figure 3.7 shows the countries ranked according their NMVOC-emission per km^2. The differences in the emissions per km^2 between countries are much larger compared to the per capita emissions. The smallest number being 20 times smaller than the largest number.

Figure 3.7: NMVOC-emissions per km^2 for individual countries

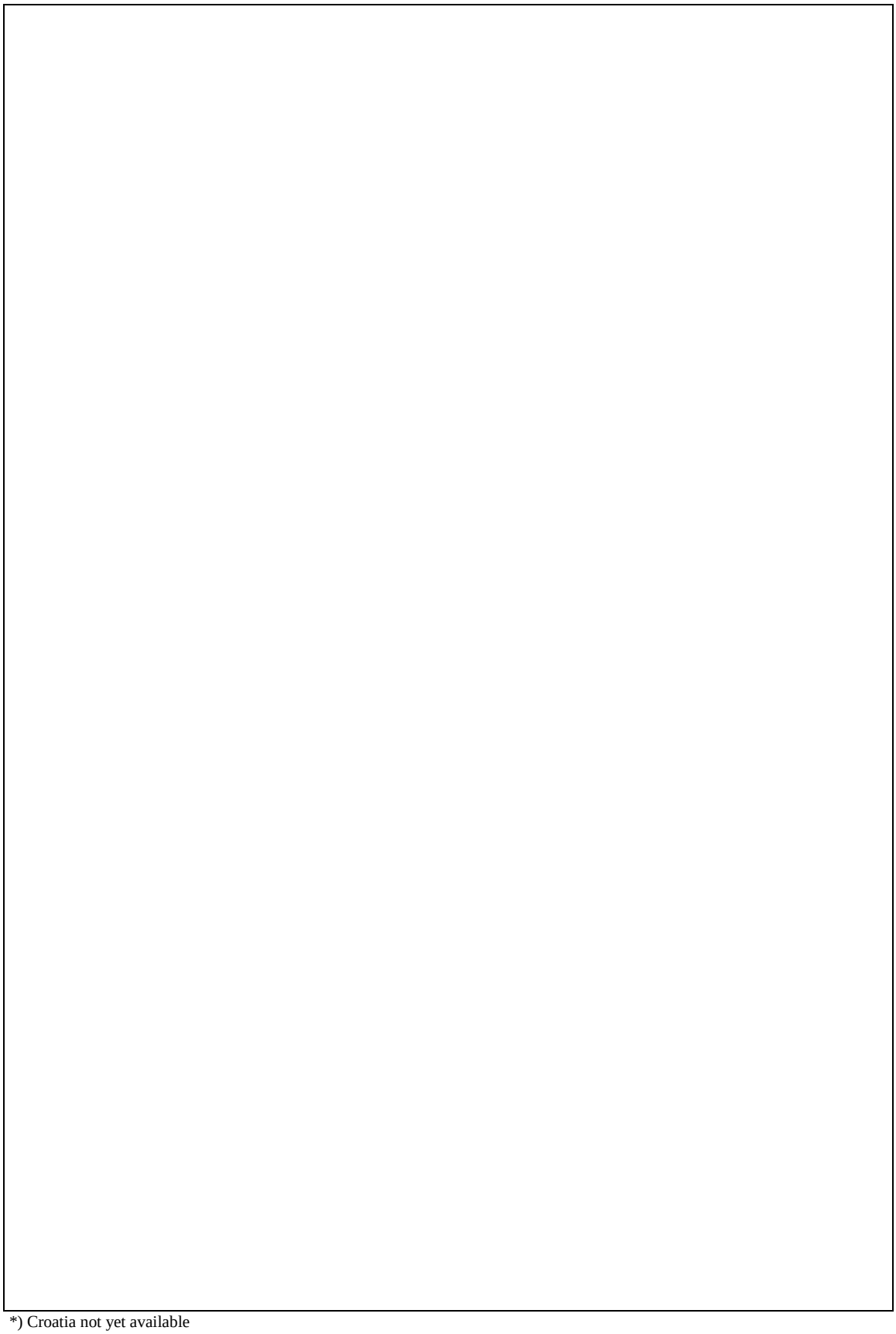


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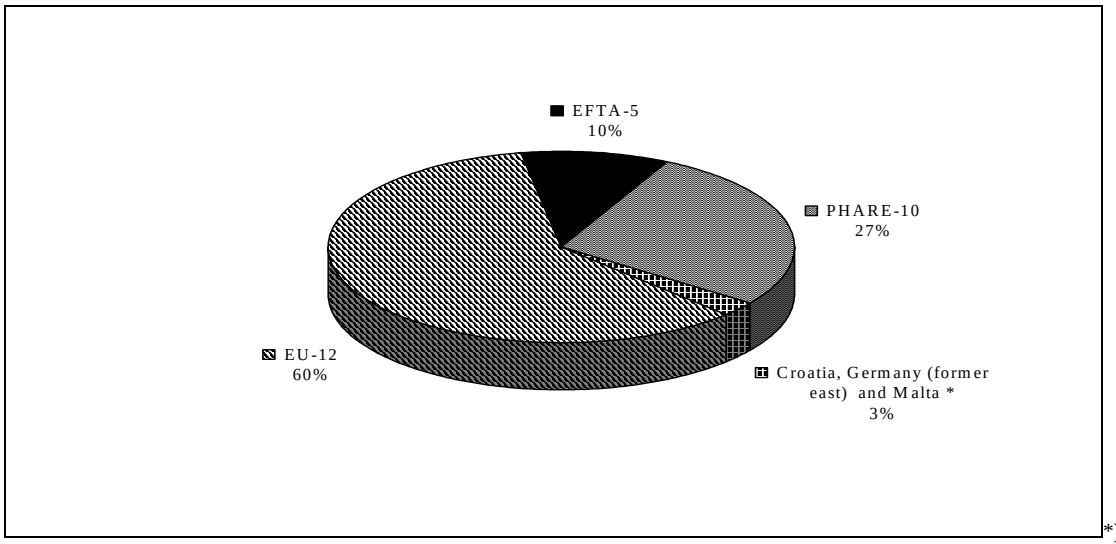
Table 3.1: Non-Methane Volatile Organic Compounds emissions per country and group

4. METHANE - CH_4

4.1 CH_4-emissions by countries

The 1990 annual total CH_4-emissions for EUROPE were estimated to be 45 million tonnes. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 4.1. The largest contributor were the EU-12 countries with 60%, second largest the PHARE-10 countries with 27%. The EFTA-5 countries contributed 10% and Germany (former East) and Malta 3%.

Figure 4.1: Contribution in % to the EUROPEAN total CH_4-emissions



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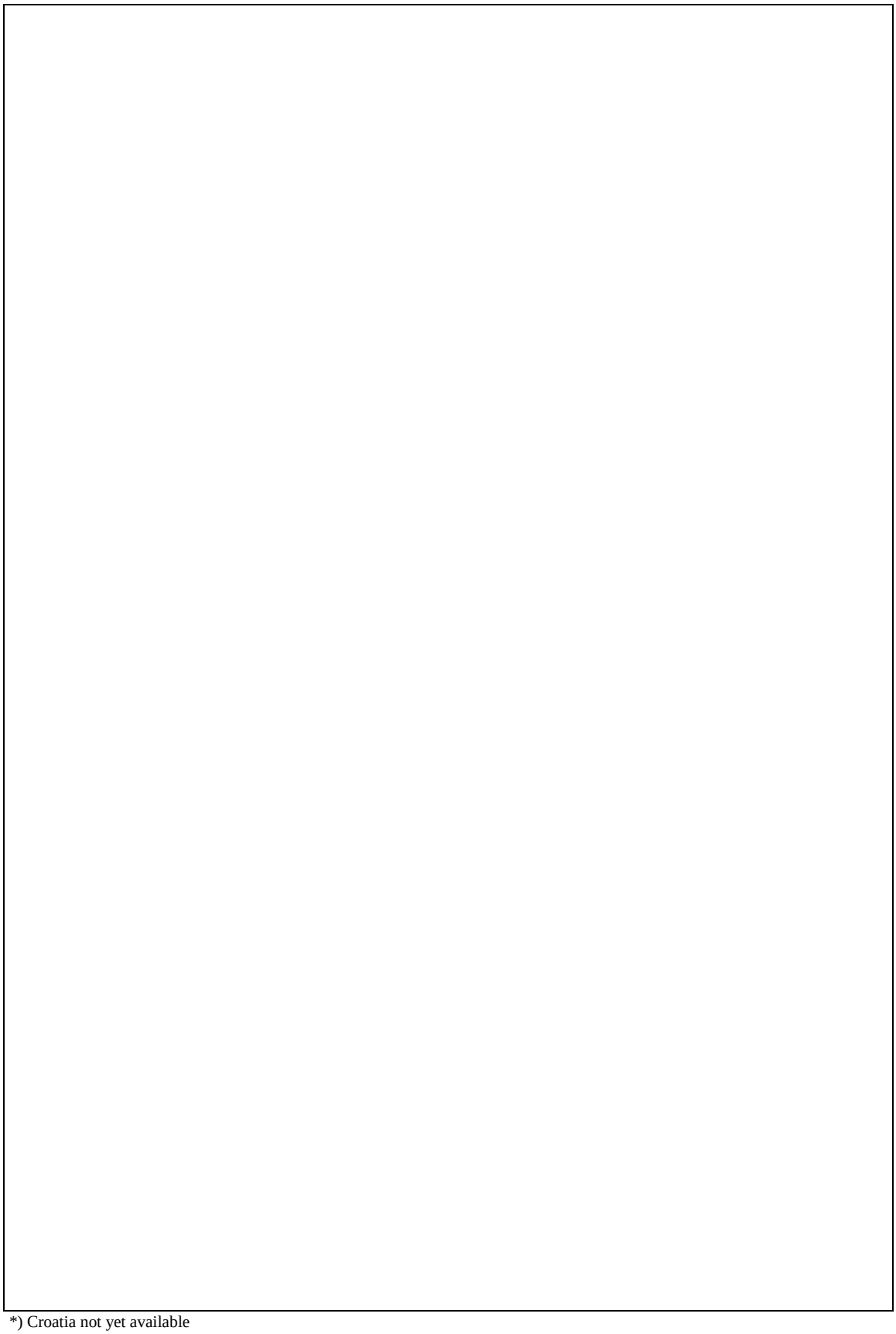
Croatia not yet available

Figure 4.2 shows the relative contribution of individual countries to the total of 45 million tonnes. In 1990 the largest contributing countries were Poland (13%), Greece (12%) and Germany (former West; 11%); the smallest contributing countries were Malta (0.02%), Luxembourg (0.06%) and Slovenia (0.3%). These differences are due to different size of population, different per capita emissions (see also paragraph 4.3) and differences in emissions from natural sources**.**

Figure 4.2: Contribution in % of each country to the EUROPEAN total CH_4-emissions



*) Croatia not yet available

4.2 CH_4-emissions per group

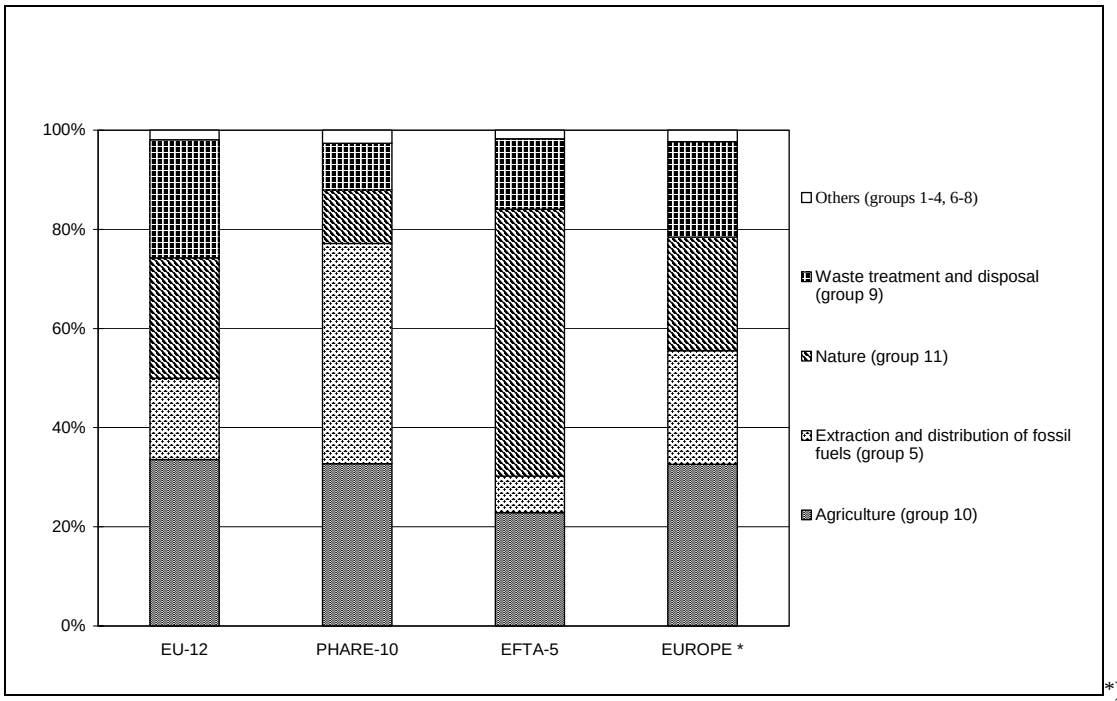
One third of the CH_4-emissions for EUROPE resulted from agriculture (group 10) in 1990. Group 11 (nature) and group 5 (extraction and distribution of fossil fuels) both contributed 23%. Group 9 (waste treatment and disposal) produced 19% and group 2 (commercial, institutional and residential combustion) contributed only 1% to the total CH_4-emissions of EUROPE. In contrast to other pollutants the groups 1 (public power, cogeneration and district heating), 3 (industrial combustion), 4 (production processes), 7 (road transport) and 8 (other mobile sources and machinery) are not relevant for CH_4-emissions.

The split of the CH_4-emissions into groups for EU-12 countries is quite similar compared to the split for EUROPE with the exception of the smaller contribution of group 5 (extraction and distribution of fossil fuels) with 16% for EU-12 countries. In the PHARE-10 countries the contribution of group 5 (extraction and distribution of fossil fuels) is 44% and thus significant higher than its contribution in EUROPE. In the PHARE-10-countries the groups 9 (waste treatment and disposal) and 11 (nature) produced 9% and 11% of the CH_4-emissions; this is much lower than the contribution of these groups in EUROPE, in the EU-12 countries and in the EFTA-5 countries. In the EFTA-5 countries more than half of the CH_4-emissions were attributed to group 11 (nature).

The differences of contributions especially of the main sourcegroups 10, 11, 5 and 9 to the total emissions are larger between countries than these groups (see also table 4.1). The relative contribution of the CH_4-emissions of group 10 ranges from 76% (Ireland) to 7% (Greece), of group 11 from 83% (Greece) to 0% (Belgium, Wallonie region and others), of group 5 from 56% (Romania) to 0% (Sweden and others) and of group 9 (waste treatment and disposal) from 80% (Malta) to 0% (Lithuania and others).

However it is evident already from these differences in the relative contribution of source groups to a countries total emissions that strategies for reduction of CH_4-emissions need individual solutions as well as common elements.

Figure 4.3: Contribution in % of source groups to the EUROPEAN CH_4-emissions



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Croatia not yet available

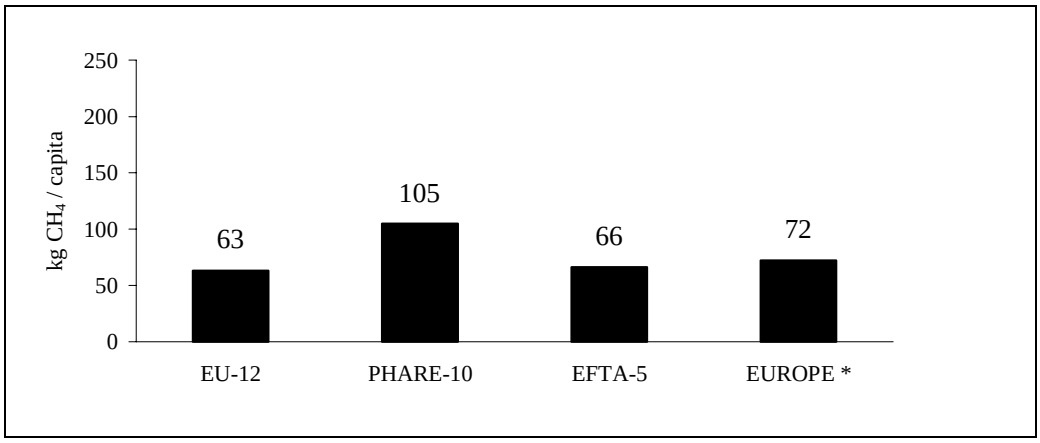
4.3 CH_4-emissions per capita

Only anthropogenic emissions are expected to be related to population for these calculations. Therefore group 11 (nature) has been excluded.

For EUROPE the average CH_4-emissions per capita were 72 kg/capita. Compared to this number the per capita CH_4-emissions were 13% smaller for the EU-12 countries with 63 kg/capita, 8% smaller for the EFTA-5 countries with 66 kg/capita and 46% larger for the PHARE-10 countries with 105 kg/capita. This comparison is also shown in figure 4.4 and table 9.

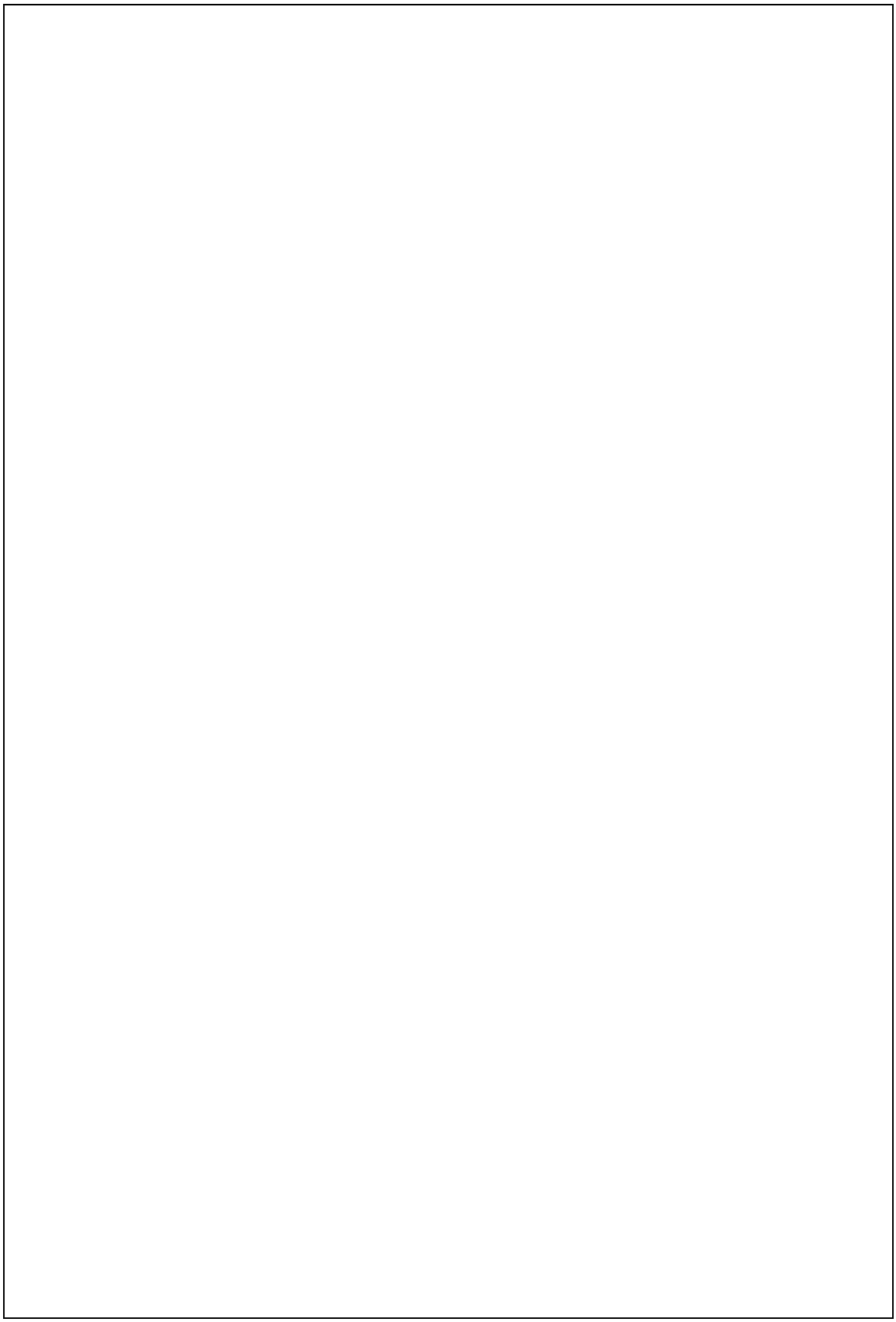
Again the differences are much larger if individual countries are compared: the largest CH_4-emissions per capita were estimated for Ireland (226 kg/capita) and the next largest ones for Poland (151 kg/capita) and Czech Republic (141 kg/capita); the smallest per capita emissions for CH_4 were calculated for Portugal (25 kg/capita), Malta (26 kg/capita) and Belgium, Flemish region (28 kg/capita). Figure 4.6 shows the countries ranked according their per capita emissions. The smallest per capita emissions is a factor of 9 smaller compared to the largest number.

Figure 4.4: CH_4-emissions per capita for EUROPE



*) Croatia not yet available

Figure 4.5: CH_4-emissions per capita for individual countries



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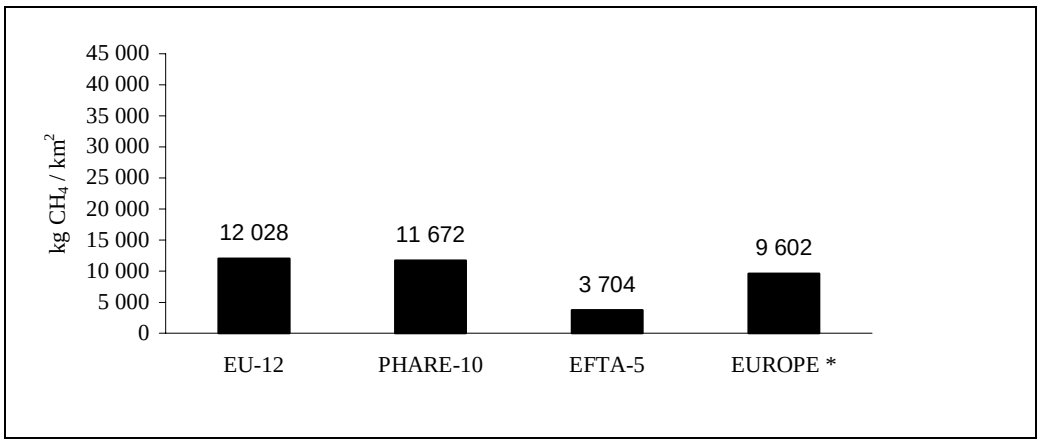
4.4 CH_4-emissions per km^2

The emissions per km^2 have been calculated from the total emissions, the emissions of group 11 (nature) having been included in this case.

For EUROPE the average CH_4-emissions per km^2 were estimated as 9 602 kg/km^2. Compared to this number the per km^2 CH_4-emissions were 25% larger for the EU-12 countries with 12 028 kg/km^2, 22% larger for the PHARE-10 countries with 11 672 kg/km^2 and 61% smaller for the EFTA-5 countries with 3 704 kg/km^2. This comparison is also shown in figure 4.6 and table 10.

Figure 4.6: CH_4-emissions per km^2 for EUROPE



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Again the differences are much larger if individual countries are compared; the largest CH_4-emissions per km^2 were for Greece (41 738 kg/km^2) and the next largest ones for Malta (28 611 kg/km^2) and the Netherlands (25 079 kg/km^2); the smallest emissions per km^2 for CH_4 were for Norway (868 kg/km^2), Finland (2 930 kg/km^2) and Lithuania (4 090 kg/km^2). Figure 4.7 shows the countries ranked according their CH_4-emission per km^2. The differences in the emissions per km^2 between countries are much larger compared to the per capita emissions. The smallest number being 48 times smaller than the largest number.

Figure 4.7: CH_4-emissions per km^2 for individual countries

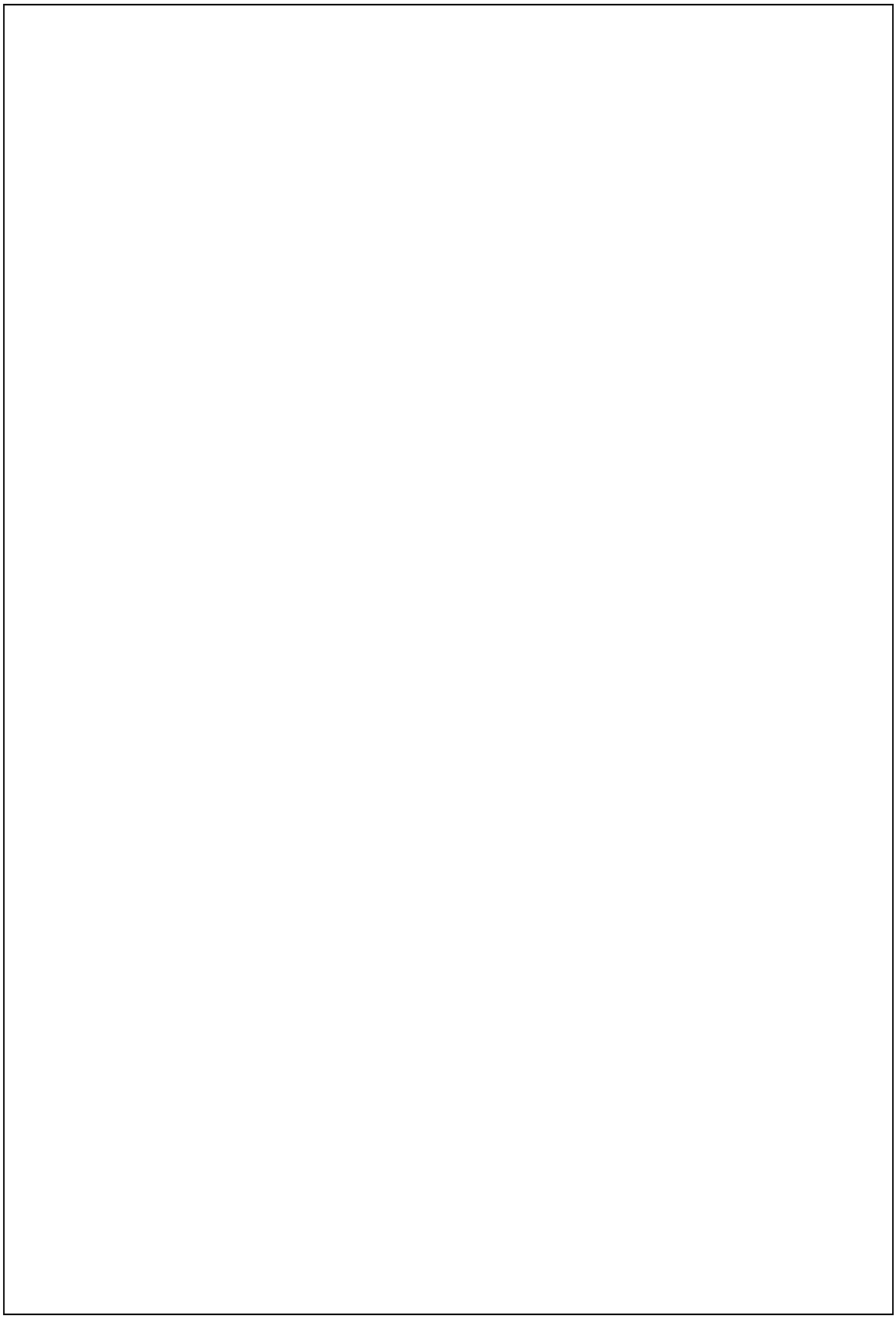

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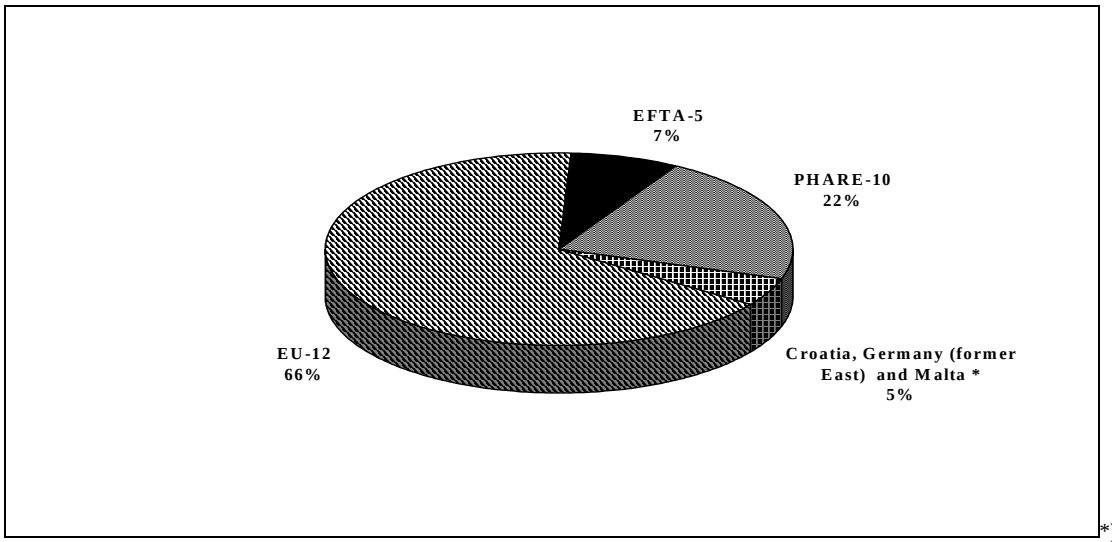
Table 4.1: Methane emissions per country and group

5. CARBON MONOXIDE - CO

5.1 CO-emissions by countries

The 1990 annual total CO-emissions for EUROPE were estimated to be 70 million tonnes. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 5.1. The largest contributor were the EU-12 countries with 66%, second largest the PHARE-10 countries with 22%; the EFTA-5 countries contributed 7% and Germany (former East) and Malta 5%.

Figure 5.1: Contribution in % to the EUROPEAN total CO-emissions



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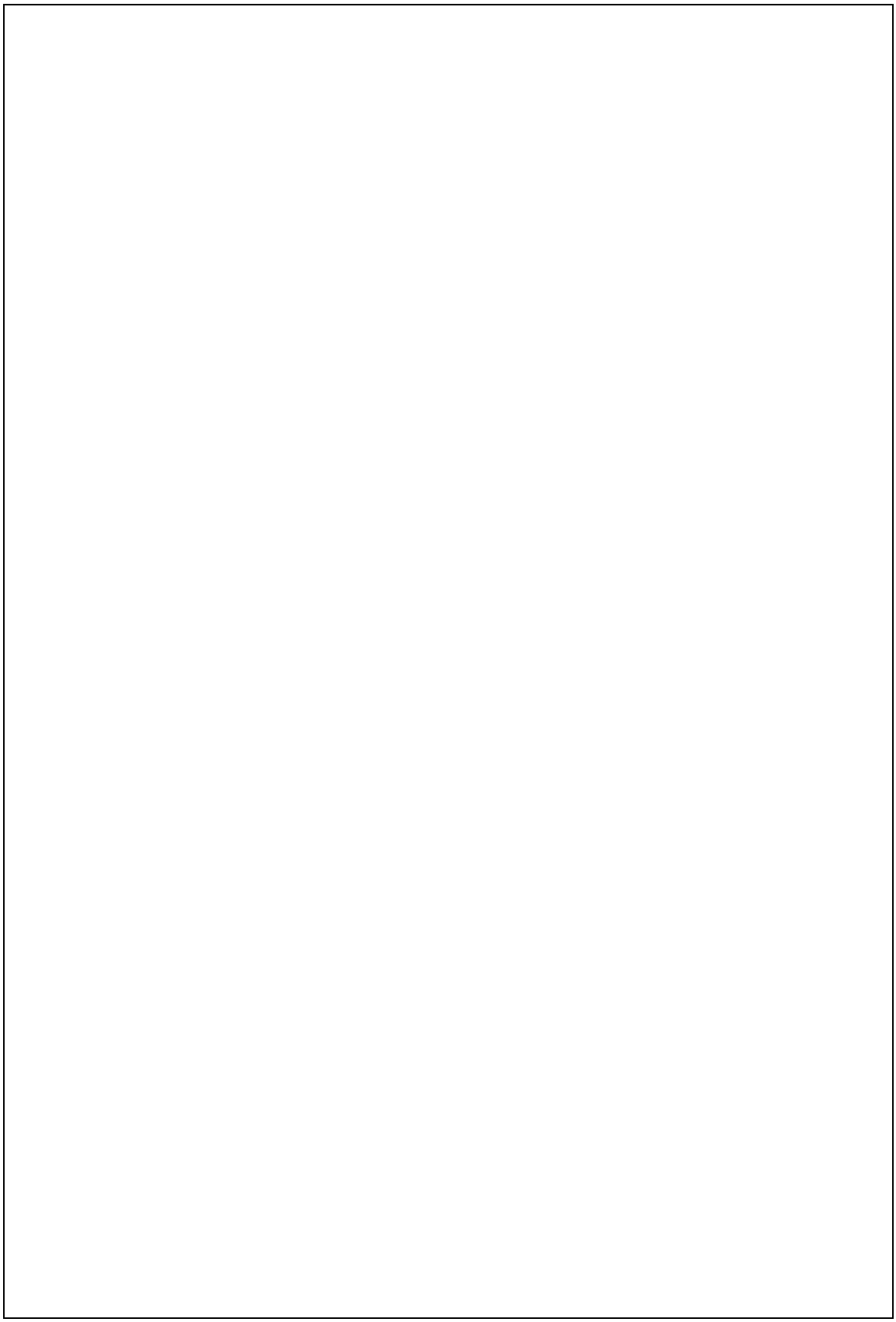
Croatia not yet available

Figure 5.2 shows the relative contribution of individual countries to the total of 70 million tonnes. In 1990 the largest contributing countries were France (16%), Italy (15%) and Poland (11%); the smallest contributing countries were Malta (0.03%), Slovenia (0.1%) and Luxembourg (0.25%). These differences are due to different size of population and different per capita emissions (see also paragraph 5.3.).

Figure 5.2: Contribution in % of each country to the EUROPEAN total CO-emissions



*) Croatia not yet available

5.2 CO-emissions per group

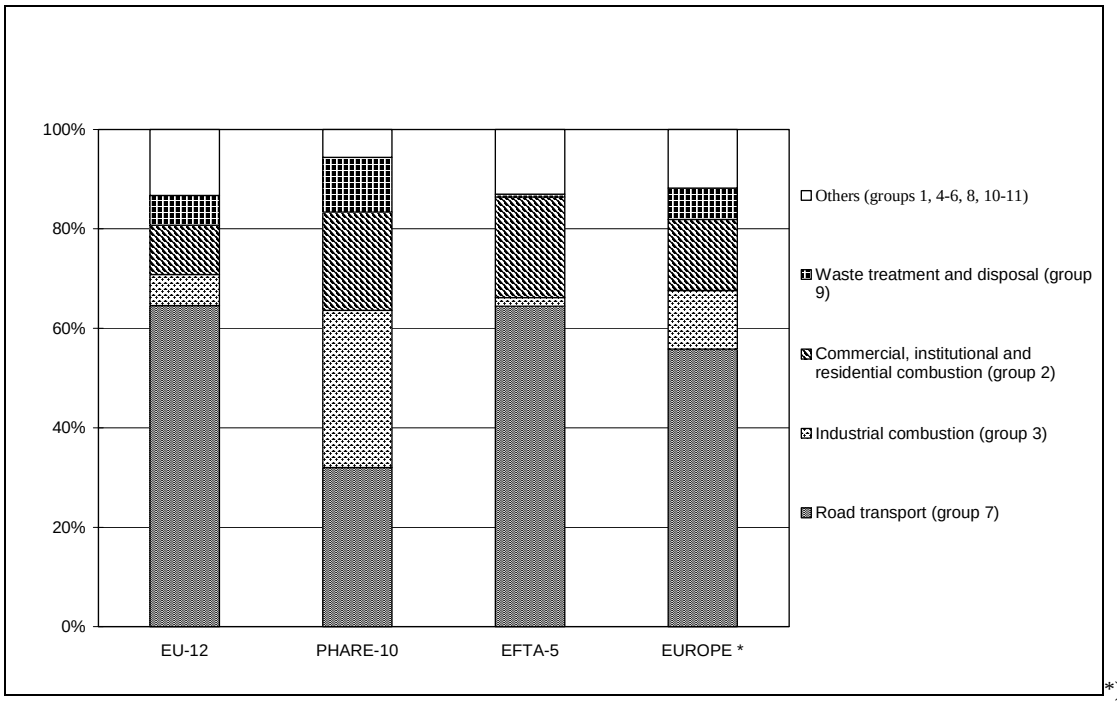
Road transport (group 7) contributed with 56% to total CO-emissions of EUROPE. About 30% of the CO-emissions for EUROPE resulted together from group 1 (public power, cogeneration and district heating), group 2 (commercial, institutional and residential combustion) and group 3 (industrial combustion) in 1990. The remaining 17% of the total emissions can be attributed almost exclusively to emissions of group 9 (waste treatment and disposal), group 4 (production processes), group 8 (other mobile sources and machinery), group 11 (nature) and group 10 (agriculture).

The split of the CO-emissions into groups for EU-12 and PHARE-10 countries is quite similar compared to the split for EUROPE with the exception of the relative larger contribution of group 3 (industrial combustion) with 32%, of group 2 (commercial, institutional and residential combustion) with 20%, of group 9 (waste treatment and disposal) with 11% and of the smaller contribution of group 7 with 32% for the PHARE-10 countries. For the EFTA-5 countries the relative contribution of group 7 (road transport) is with 64% and of group 3 (commercial, institutional and residential combustion) is with 2% smaller than the average of EUROPE.

The differences of contributions of the main source groups 7, 2, 3, and 4 to the total emissions are larger between countries than these groups (see also table 5.1). The relative contribution of groups 7 CO-emissions ranges from 91% (Malta) to 14% (Czech Republic), of group 2 from 48% (Czech Republic) to 0.4% (Finland), of group 3 from 57% (Luxembourg) to 0% (Malta, Greece, Latvia) and of group 4 from 23% (Netherlands) to 0% (Malta and others).

However it is evident from these differences in the relative contribution of sourcegroups to a countries total emissions that strategies for reduction of CO-emissions need individual solutions as well as common elements.

Figure 5.3: Contribution in % of source groups to the EUROPEAN CO-emissions



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Croatia not yet available

5.3 CO-emissions per capita

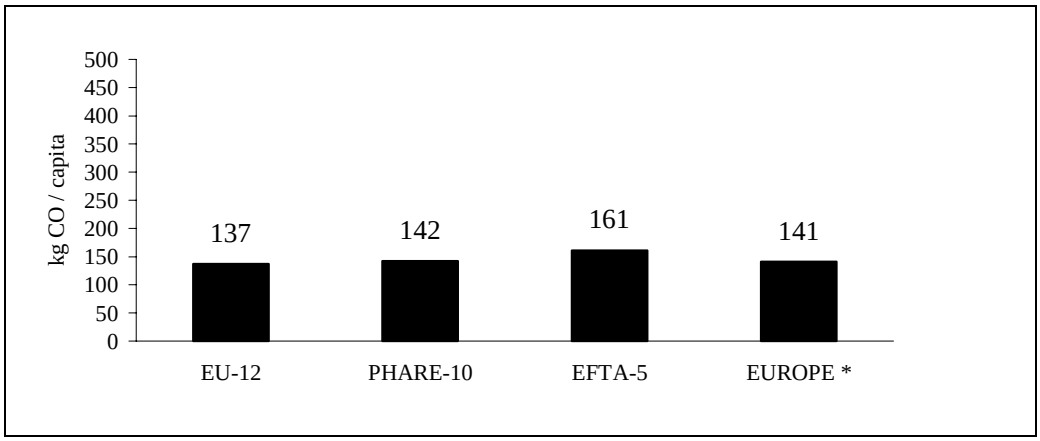
Only anthropogenic emissions are expected to be related to population for these calculations. Therefore group 11 (nature) has been excluded.

For EUROPE the average CO-emissions per capita were 141 kg/capita. Compared to this number the per capita CO-emissions were 1% larger for the PHARE-10 countries with 142 kg/capita, 3% smaller for the EU-12 countries with 137 kg/capita and 14% larger for the EFTA-5 countries with 161 kg/capita. This comparison is also shown in figure 5.4 and table 9.

Again the differences are much larger if individual countries are compared: the largest CO-emissions per capita were estimated for Luxembourg (454 kg/capita) and the next largest ones for Norway (225 kg/capita), Austria (222 kg/capita), Estonia (220 kg/capita) and Germany (former East; 201 kg/capita); the smallest per capita emissions for CO were calculated for Slovenia (39 kg/capita), Malta (66 kg/capita) Hungary and the Netherlands (each 73 kg/capita) and Finland (91 kg/capita). Figure 5.5 shows the

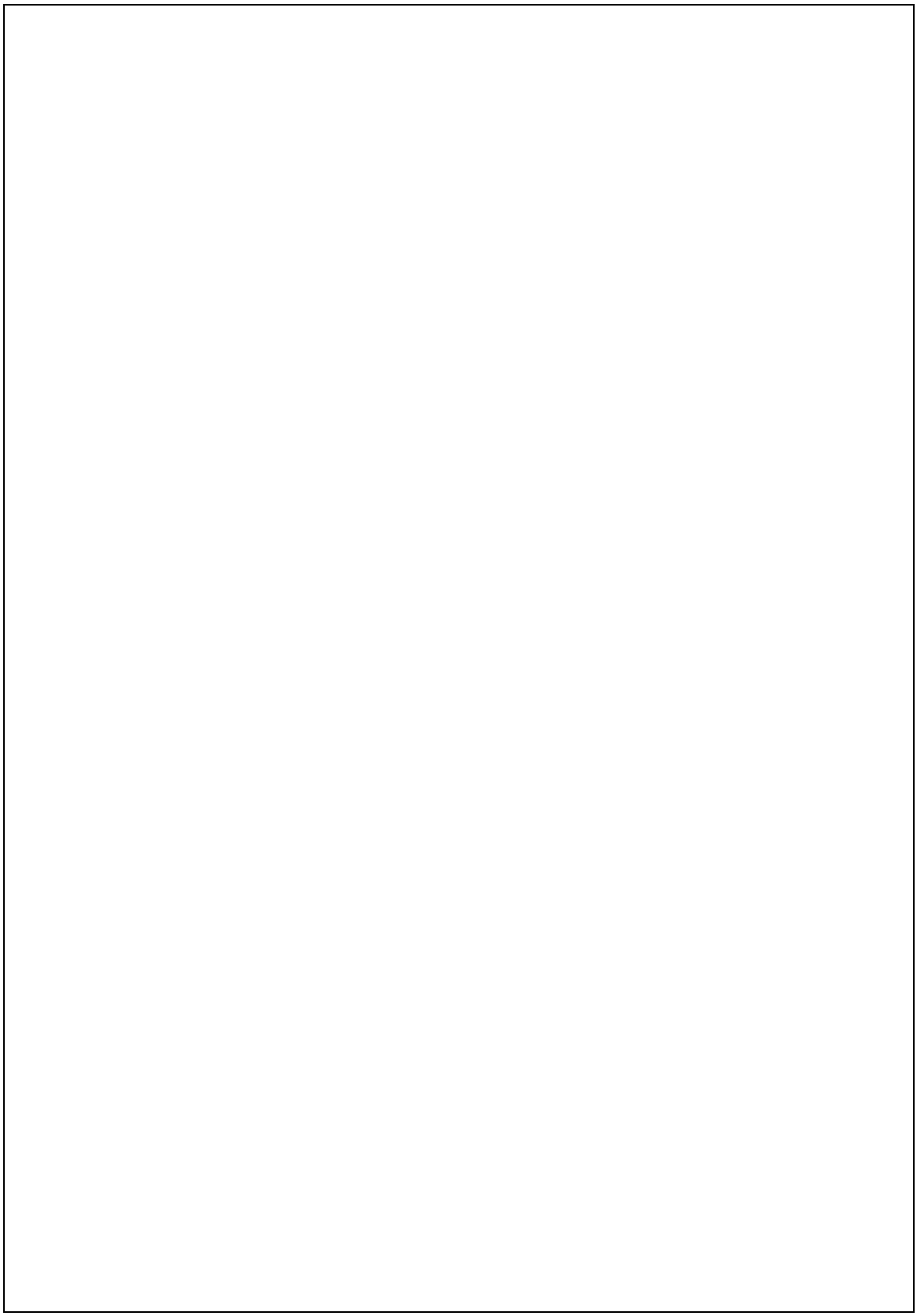
countries ranked according their per capita emissions. The smallest per capita emissions is a factor of 12 smaller compared to the largest number.

Figure 5.4: CO-emissions per capita for EUROPE



*) Croatia not yet available

Figure 5.5: CO-emissions per capita for individual countries



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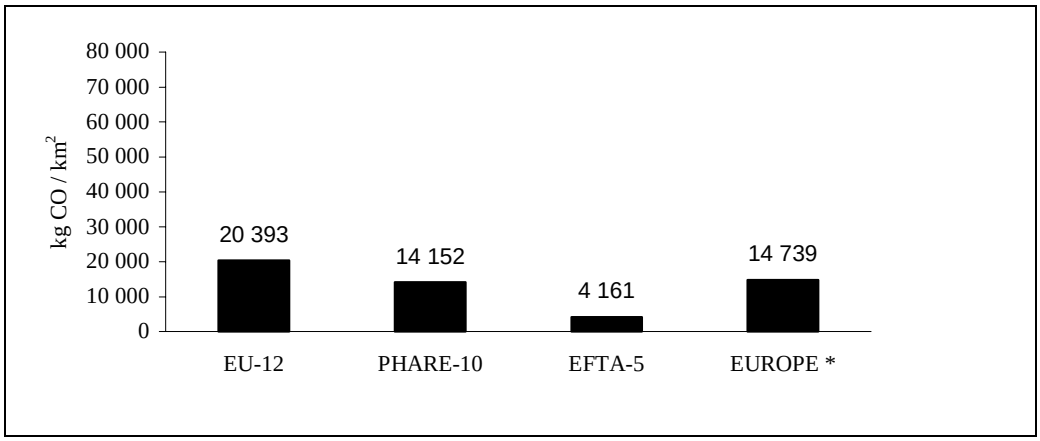
5.4 CO-emissions per km^2

The emissions per km^2 have been calculated from the total emissions, the emissions of group 11 (nature) having been included in this case.

For EUROPE the average CO-emissions per km^2 were estimated as 14 739 kg/km^2. Compared to this number the per km^2 CO-emissions were 38% larger for the EU-12 countries with 20 393 kg/km^2, 4% smaller for the PHARE-10 countries with 14 152 kg/km^2 and 72% smaller for the EFTA-5 countries 4 161 kg/km^2. This comparison is also shown in figure 5.6 and table 10.

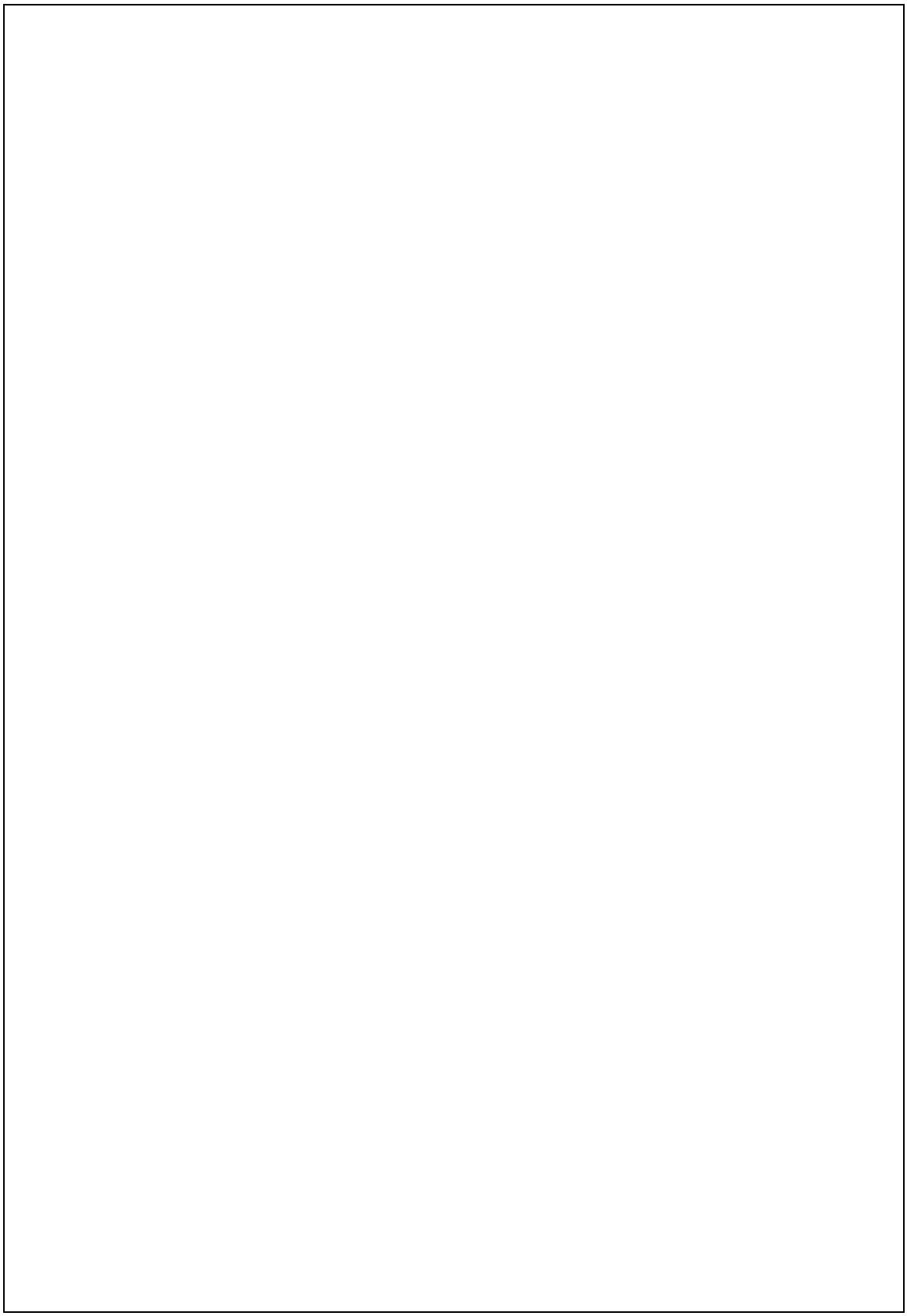
Figure 5.6: CO-emissions per km^2 for EUROPE



*) Croatia not yet available

Again the differences are much larger if individual countries are compared; the largest CO-emissions per km^2 were for Malta (72 953 kg/km^2) and the next largest ones for Luxembourg (66 211 kg/km^2) and Belgium, Flemish region (58 167 kg/km^2); the smallest emissions per km^2 for CO were for Finland (1 340 kg/km^2), Norway (2 932 kg/km^2), Sweden (2 994 kg/km^2) and Slovenia (3 786 kg/km^2). Figure 5.7 shows the countries ranked according their CO-emissions per km^2. The differences in the emissions per km^2 between countries are much larger compared to the per capita emissions. The smallest number being 54 times smaller than the largest number.

Figure 5.7: CO-emissions per km^2 for individual countries



*) Croatia not yet available

Table 5.1: Carbon monoxide emissions per country and group

6. CARBON DIOXIDE - CO_2

6.1 CO_2-emissions by countries

The 1990 annual total CO_2-emissions for EUROPE were estimated to be 4 764 million tonnes. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 6.1. The largest contributor were the EU-12 countries with 64%, second largest the PHARE-10 countries with 22%; EFTA-5 countries with 8% and Germany (former East) and Malta contributed 6%.

Figure 6.1: Contribution in % to the EUROPEAN total CO_2-emissions

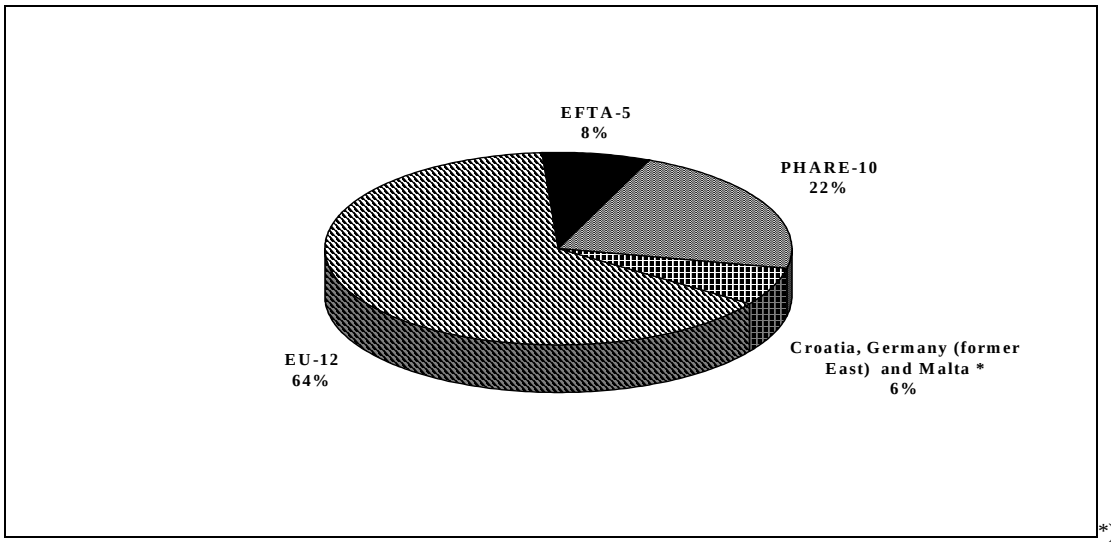


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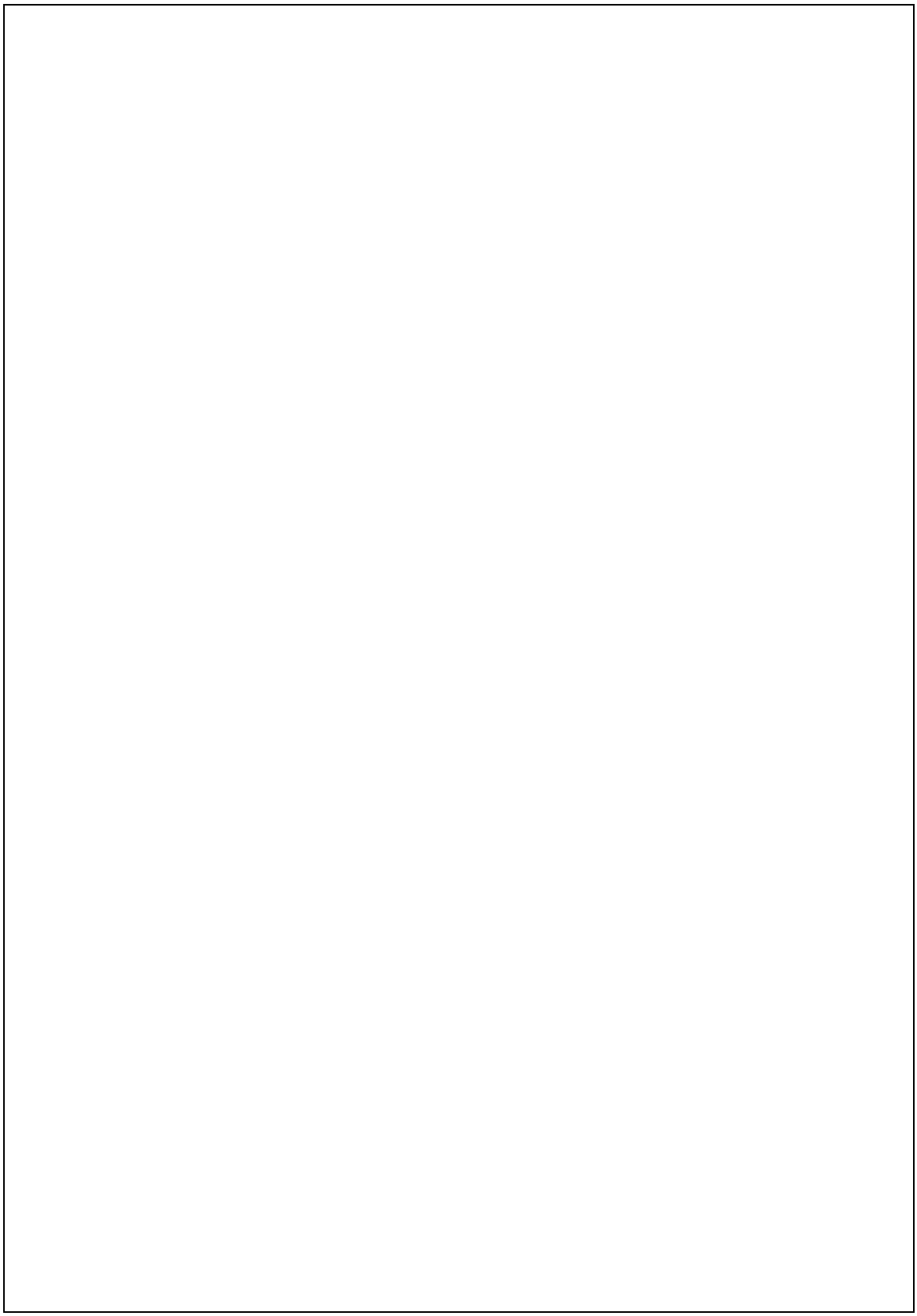
Figure 6.2 shows the relative contribution of individual countries to the total of 4 765 million tonnes. In 1990 the largest contributing countries were Germany (former West; 15%), the United Kingdom (12%), Italy (10%) and France (10%); the smallest contributing countries were Malta (0.05%), Luxembourg (0.2%) and Slovenia (0.3%). These differences are due to different size of population and different per capita emissions (see also paragraph 6.3).

Figure 6.2: Contribution in % of each country to the EUROPEAN total CO_2-emissions



*) Croatia not yet available

6.2 CO_2-emissions per group

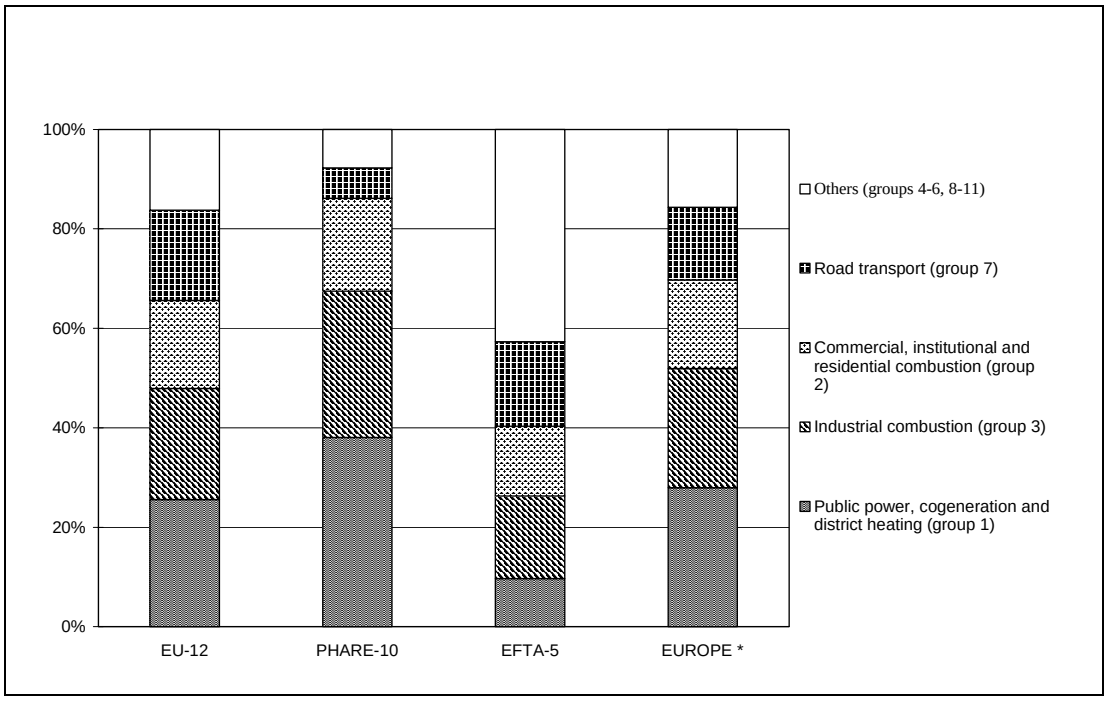
Eighty-five percent of the CO_2-emissions for EUROPE resulted from the groups 1 (public power, cogeneration and district heating), group 2 (commercial, institutional and residential combustion), group 3 (industrial combustion) and group 7 (road transport). Group 1 contributed the largest share with 28% to the total, group 3, group 2 and group 7 (road transport) were the groups with the next largest contributions of 24%, 18% and 15%. The remaining 16% of the total emissions can be attributed almost exclusively to emissions of the groups 4 (production processes), 5 (extraction and distribution of fossil fuels), 8 (other mobile sources and machinery), 9 (waste treatment and disposal) and 11 (nature).

The split of the CO_2-emissions into groups for EU-12 and PHARE-10 countries is quite similar compared to the split for EUROPE with the exception of the relative large contribution of group 1 (public power, cogeneration and district heating plants) with 38% and a smaller contribution of the group 7 (road transport) with 6% for the PHARE-10 countries. For the EFTA-5 countries group 11 (nature) showed a larger contribution with 25% and groups 1, 2 and 3 with 10%, 14% and 17% a smaller contribution compared to the split for EUROPE.

The differences of contributions of individual source groups to the total emissions are larger between countries than these groups (see also table 6.1). The contribution of group 1 ranges from 65% (Estonia) to 1% (Norway, Switzerland), of group 2 from 39% (Switzerland) to 2% (Greece), of group 3 from 58% (Luxembourg) to 2% (Greece) and of group 7 (road transport) from 26% (Austria) to 2% (Romania).

However it is evident from these differences in the relative contribution of sourcegroups to a countries total emissions that strategies for reduction of CO_2-emissions need individual solutions as well as common elements.

Figure 6.3: Contribution in % of source groups to the EUROPEAN CO_2-emissons

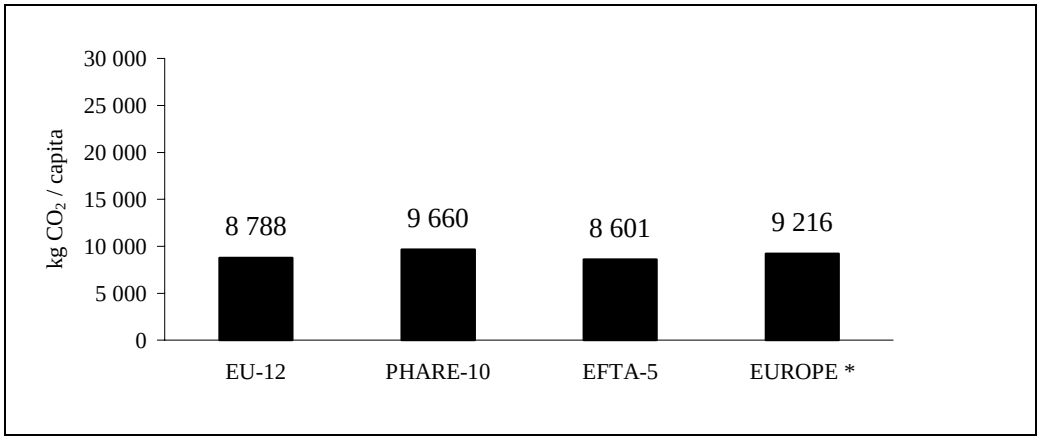


*) Croatia not yet available

6.3 CO_2-emissions per capita

For EUROPE the average CO_2-emissions per capita were 9 216 kg/capita. Compared to this number the per capita CO_2-emissions were 5% larger for the PHARE-10 countries with 9 660 kg/capita, 5% smaller for the EU-12 countries with 8 788 kg/capita and 7% smaller for the EFTA-5 countries with 8 601 kg /capita. This comparison is also shown in figure 6.4 and table 9.

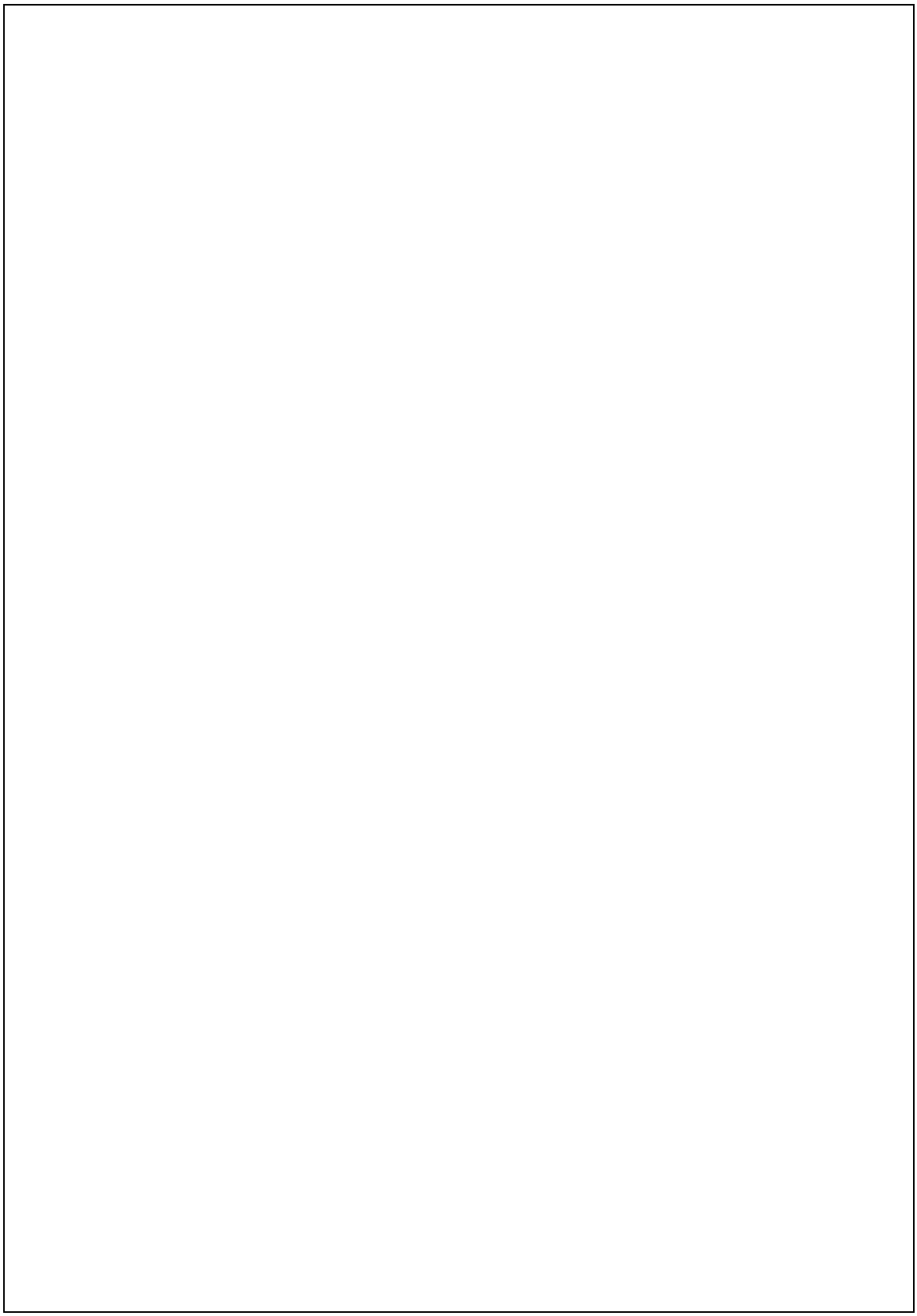
Figure 6.4: CO_2-emissions per capita for EUROPE



*) Croatia not yet available

Again the differences are much larger if individual countries are compared: the largest CO_2-emissions per capita were estimated for Luxembourg (29 546 kg/capita) and the next largest ones for Estonia (18 891 kg/capita) and for Germany (former East; 18 244 kg/capita); the smallest per capita emissions for CO_2 were calculated for Portugal (4 587 kg/capita), Hungary (5 663 kg/capita) and France (6 641 kg/capita). Figure 6.5 shows the countries ranked according their per capita emissions. The already mentioned special report for CO_2 will analyse these large differences in the per capita emissions for CO_2; the smallest per capita emissions being a factor of 6 smaller compared to the largest number.

Figure 6.5: CO_2-emissions per capita for individual countries

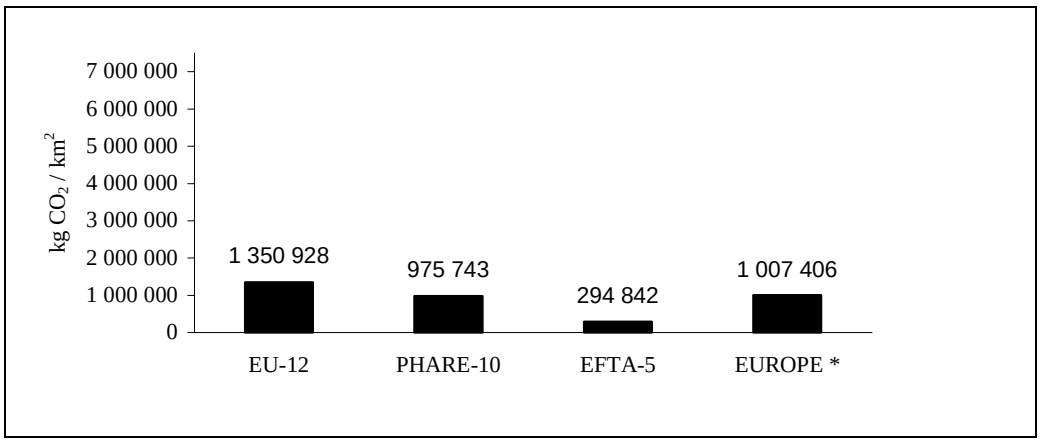


*) Croatia not yet available

6.4 CO_2-emissions per km^2

For EUROPE the average CO_2-emissions per km^2 were estimated as 1 007 406 kg/km^2. Compared to this number the per km^2 CO_2-emissions were 34% larger for the EU-12 countries with 1 350 928 kg/km^2, 3% smaller for the PHARE-10 countries with 975 743 kg/km^2 and 71% smaller for the EFTA-5 countries with 294 842 kg/km^2. This comparison is also shown in figure 6.6 and table 10.

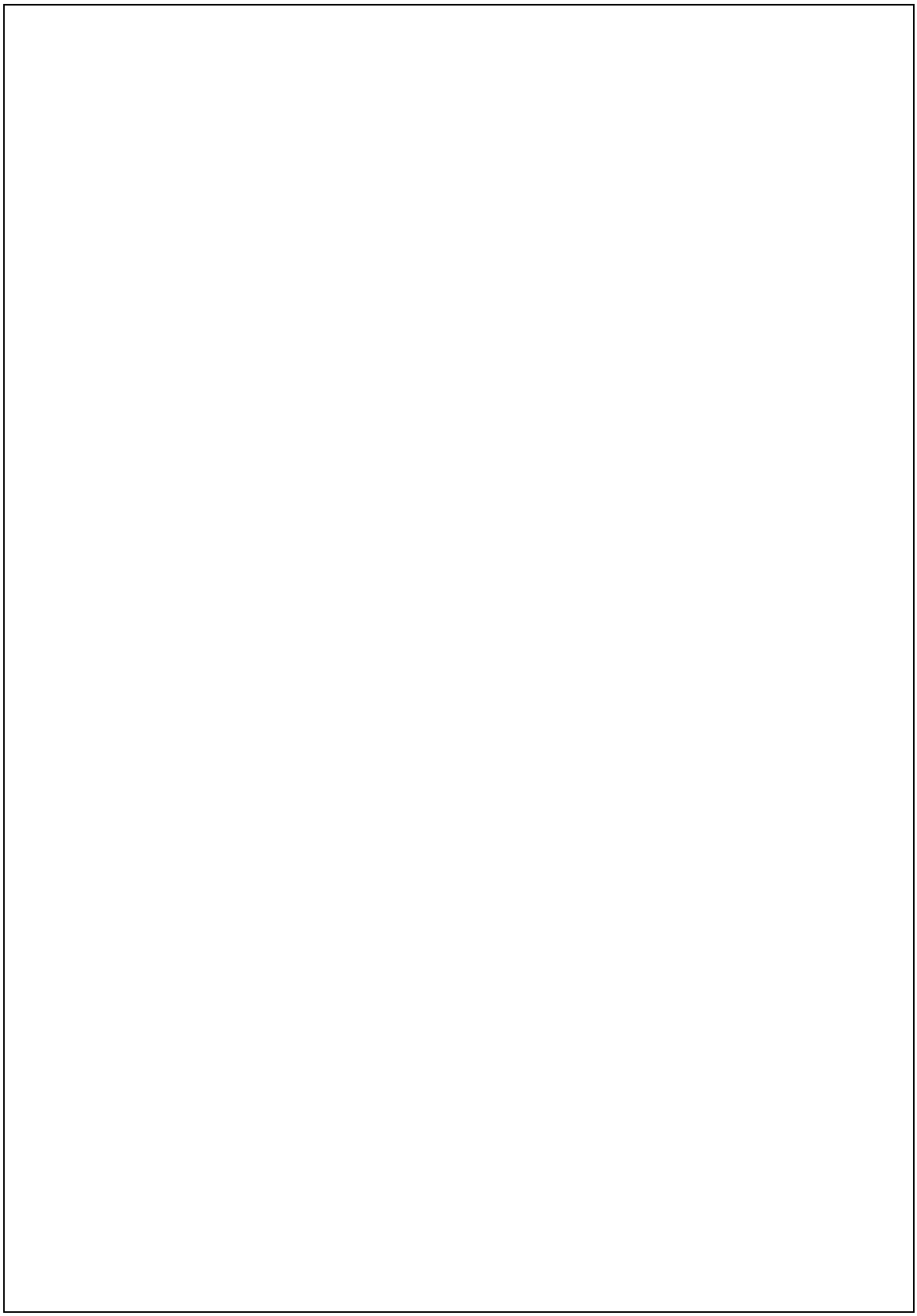
Figure 6.6: CO_2-emissions per km2 for EUROPE



*) Croatia not yet available

Again the differences are much larger if individual countries are compared; the largest CO_2-emissions per km^2 were for Malta (6 987 342 kg/km^2) and the next largest ones for Luxembourg (4 348 028 kg/km^2), Belgium, Flemish region (3 901 938 kg/km^2) and the Netherlands (3 840 638 kg/km^2). The smallest emissions per km^2 for CO_2 were for Norway (106 215 kg/km^2), Finland (168 737 kg/km^2) and Latvia (283 800 kg/km^2). Figure 6.7 shows the countries ranked according their CO_2-emission per km^2. The differences in the emissions per km^2 between countries are much larger compared to the per capita emissions. The smallest number being 66 times smaller than the largest number.

Figure 6.7: CO_2-emissions per km2 for individual countries



*) Croatia not yet available

Table 6.1: Carbon dioxide emissions per country and group

7. NITROUS OXIDE - N_2O

7.1 N_2O-emissions by countries

The 1990 annual total N_2O-emissions for EUROPE were estimated to be 1.9 million tonnes. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 7.1. The largest contributor were the EU-12 countries with 69%, second largest the PHARE-10 countries with 24%; the EFTA-5 countries contributed 5% and Germany (former East) and Malta 2%.

Figure 7.1: Contribution in % to the EUROPEAN total N_2O-emissions

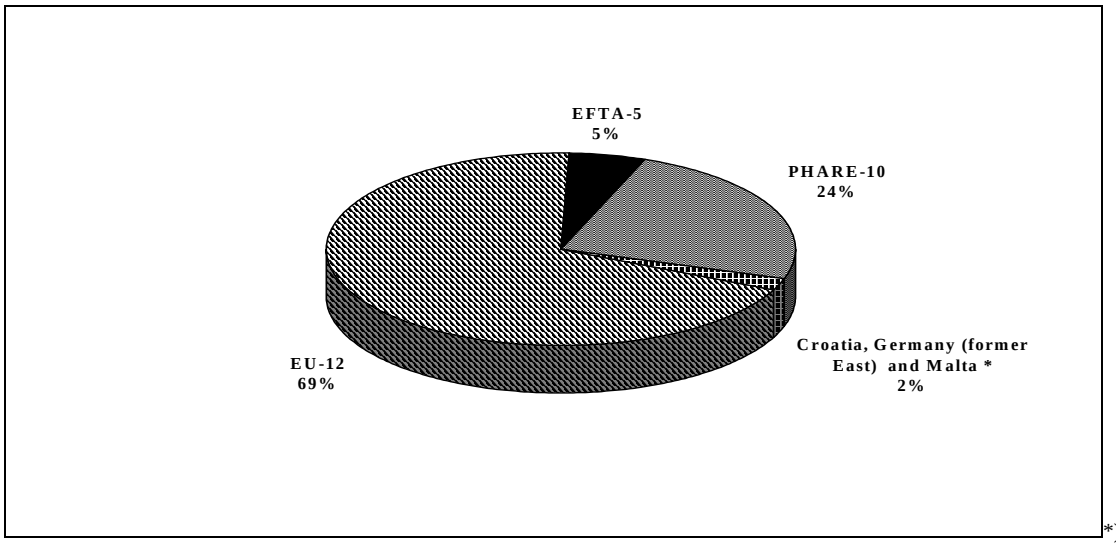


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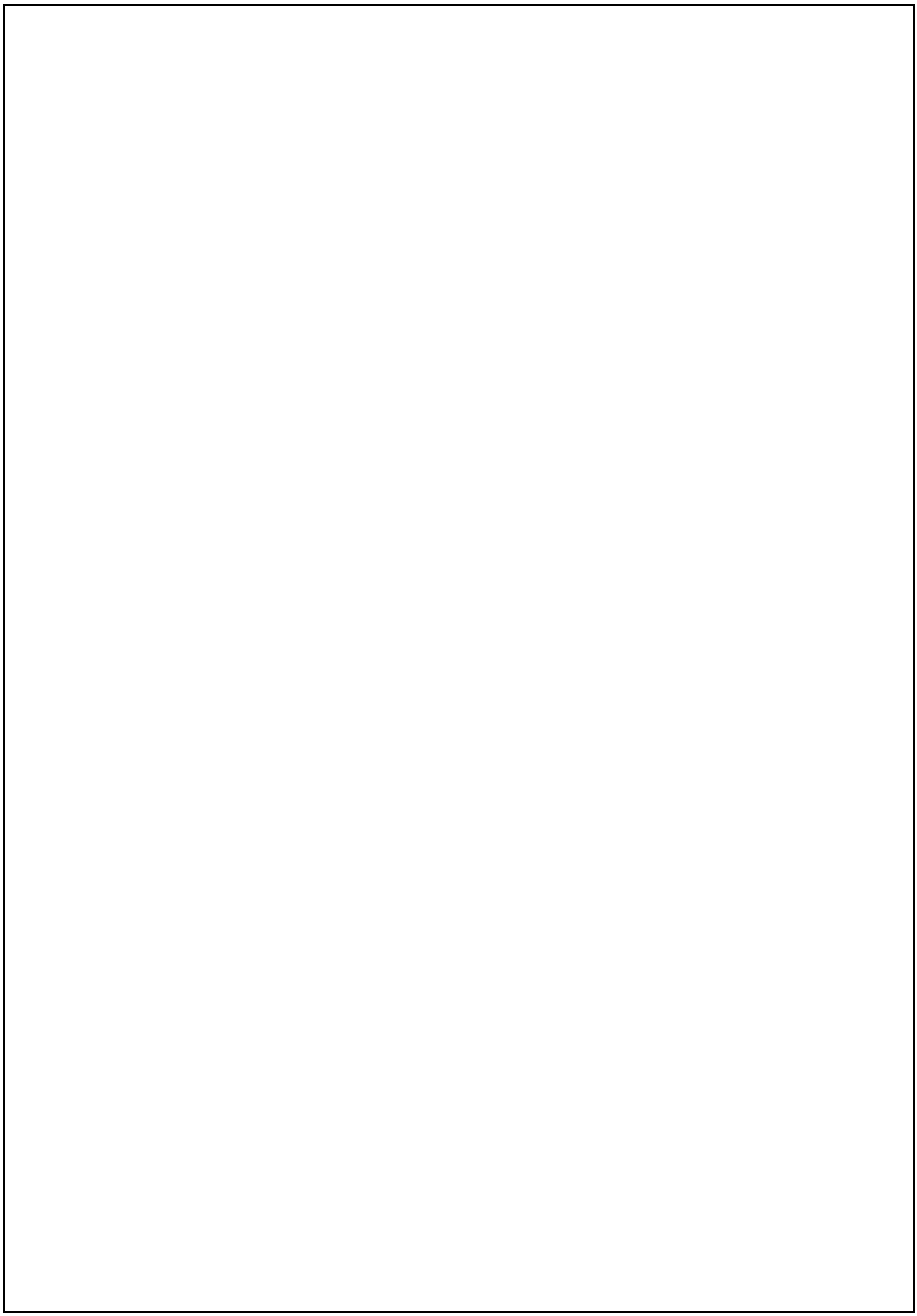
Figure 7.2 shows the relative contribution of individual countries to the total of 1.9 million tonnes. In 1990 the largest contributing countries were France (12%), Spain and Greece (each 11%); the smallest contributing countries were Malta (0.004%), Luxembourg (0.04%), Estonia (0.2%) and Austria (0.4%).These differences are due to different size of population, different per capita emissions (see also paragraph 7.3) and differences in emissions from natural sources.

Figure 7.2: Contribution in % of each country to the EUROPEAN total N_2O-emissions



*) Croatia not yet available

7.2 N_2O-emissions per group

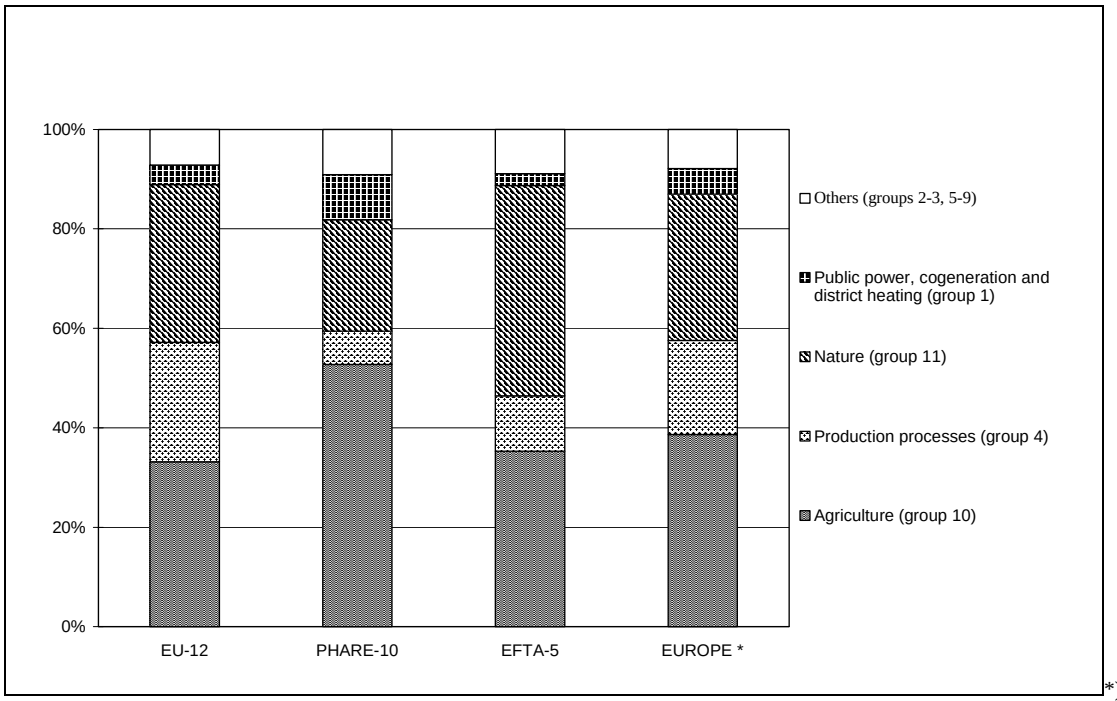
More than two thirds of the N_2O-emissions for EUROPE resulted together from agriculture (group 10, 39%) and nature (group 11, 29%) in 1990. Group 4 (production processes) contributed with 19% and group 1 (public power, cogeneration and district heating) with 5% to the N_2O-emissions. Group 2 (commercial, institutional and residential combustion), group 3 (industrial combustion), group 7 (road transport) and group 9 (waste treatment and disposal) produced the remaining 8% of the N_2O-emissions in EUROPE. Other groups were not relevant for N_2O-emissions.

The split of the N_2O-emissions into groups for EU-12 countries, PHARE-10 countries and EFTA-5 countries is quite similar compared to the split for EUROPE with the exception of the larger contribution of group 1 (public power, cogeneration and district heating; 9%) and group 10 (agriculture; 53%) in the PHARE-10 countries as well as of group 4 (production processes; 24%) in the EU-12 countries and the smaller contribution of group 4 (7%) in the PHARE-10 countries.

The differences of contributions especially of the main source groups 11, 10, 4 and 1 to the total emissions are larger between countries than these groups (see also table 7.1). The relative contribution of the N_2O-emissions of group 11 (nature) ranges from 88% (Greece) to 0% (Norway, Hungary, Malta and United Kingdom), of group 10 (agriculture) from 88% (Ireland and Lithuania) to 6% (Greece), of group 4 (production processes) from 53% (Germany former West) to 0% (Denmark and others) and of group 1 (public power, cogeneration and district heating) from 16% (Belgium, Flemish region) to 0% (the Netherlands, Norway and Switzerland).

However it is evident from these differences in the relative contribution of sourcegroups to a countries total emissions that strategies for reduction of N_2O-emissions need individual solutions as well as common elements.

Figure 7.3: Contribution in % of source groups to the EUROPEAN N_2O-emissions



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7.3 N_2O-emissions per capita

Only anthropogenic emissions are expected to be related to population for these calculations. Therefore group 11 (nature) has been excluded.

For EUROPE the average N_2O-emissions per capita were 3 kg/capita. Compared to this number the per capita N_2O-emissions were equal for the EU-12 countries with 3 kg/capita, 33% smaller for the EFTA-5 countries with 2 kg/capita and equal for the PHARE-10. This comparison is also shown in figure 7.4 and table 9.

Significant different to the average of EUROPE are the per capita N_2O-emissions in Ireland with 12 kg/capita. The smallest per capita N_2O-emissions were in Malta with 0 kg/capita, Austria and the Netherlands with 1 kg/capita (see figure 7.5). In most of the countries the per capita N_2O-emissions are between 2 kg/capita and 4 kg/capita. The smallest per capita emissions is a factor of larger than 12 smaller compared to the largest number.

Figure 7.4: N_2O-emissions per capita for EUROPE

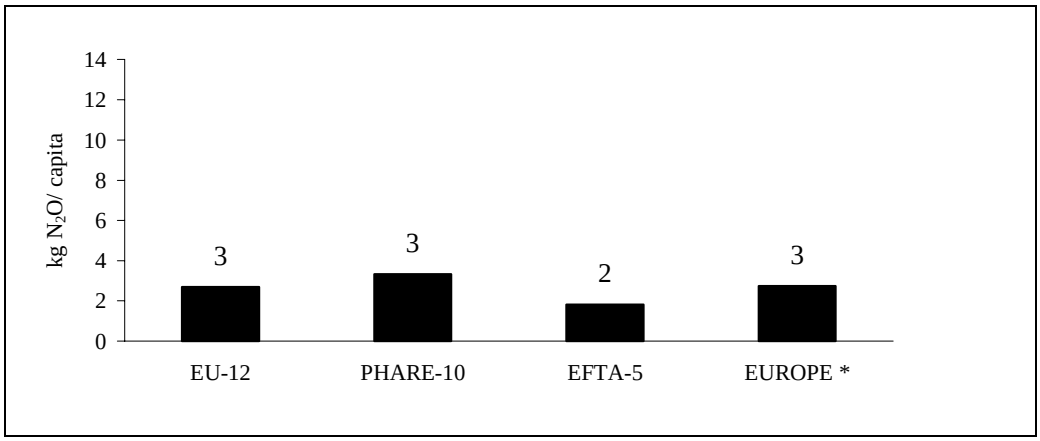

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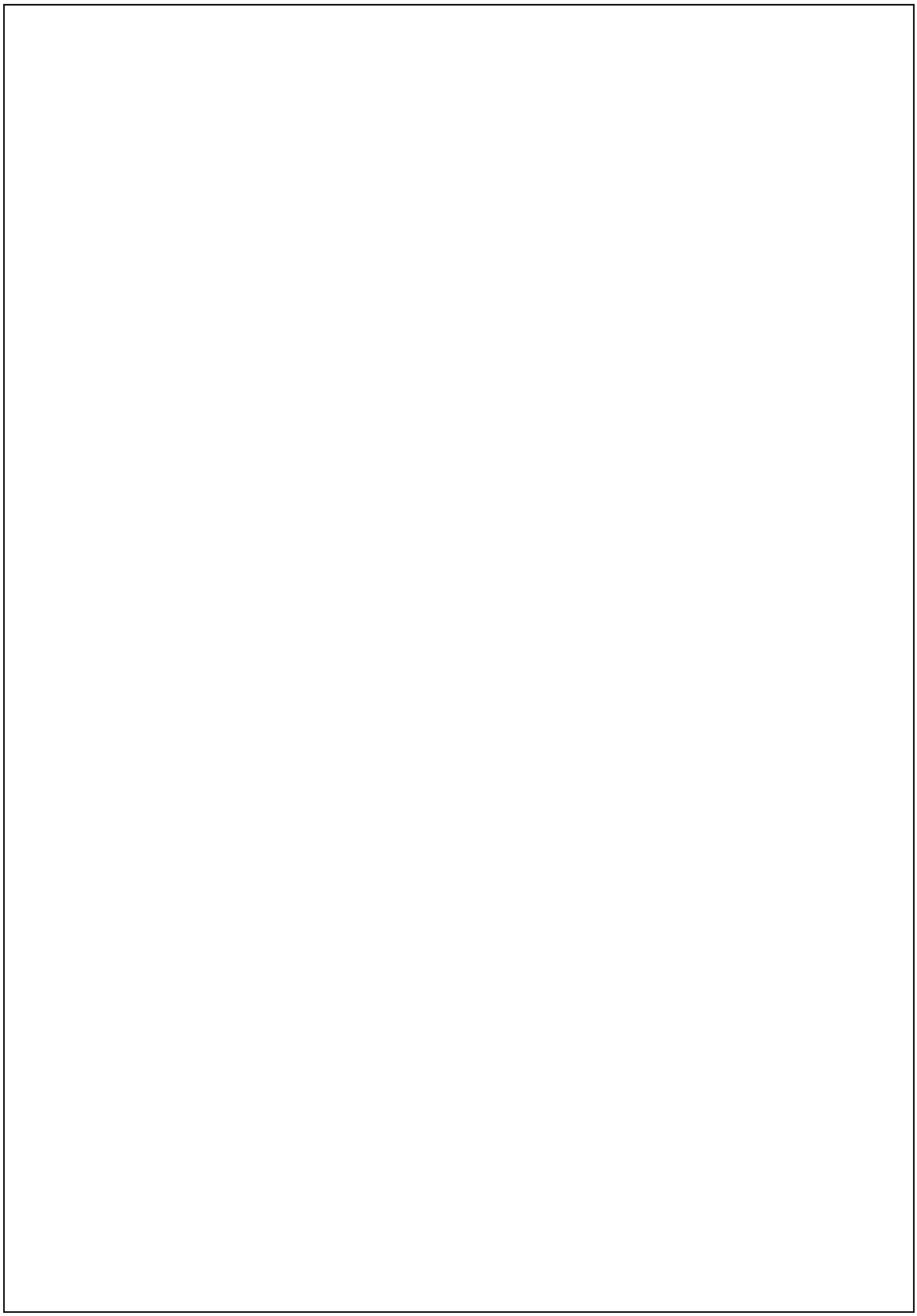
Figure 7.5: N_2O-emissions per capita for individual countries



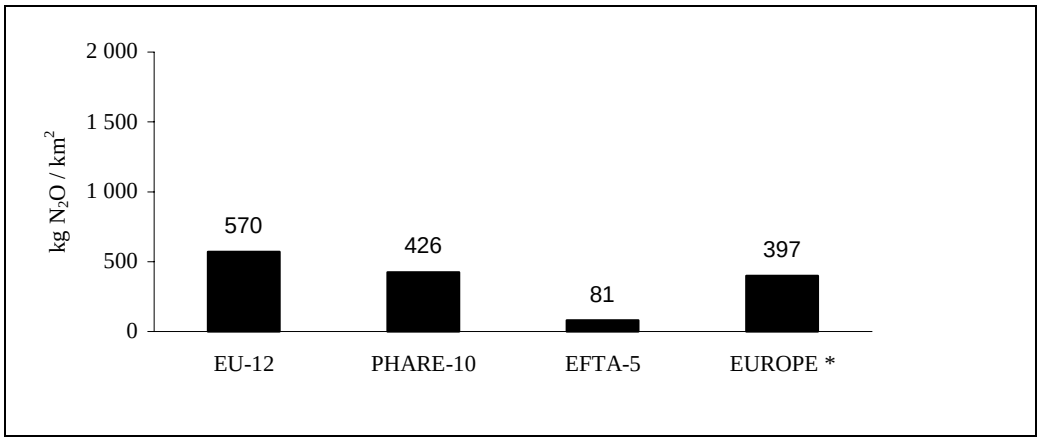
*) Croatia not yet available

7.4 N_2O-emissions per km^2

The emissions per km^2 have been calculated from the total emissions, the emissions of group 11 (nature) having been included in this case.

For EUROPE the average N_2O-emissions per km^2 were estimated as 397 kg/km^2. Compared to this number the per km^2 N_2O-emissions were 44% larger for the EU-12 countries with 570 kg/km^2, 7% larger for the PHARE-10 countries with 426 kg/km^2 and 80% smaller for the EFTA-5 countries with 81 kg/km^2. This comparison is also shown in figure 7.6 and table 10.

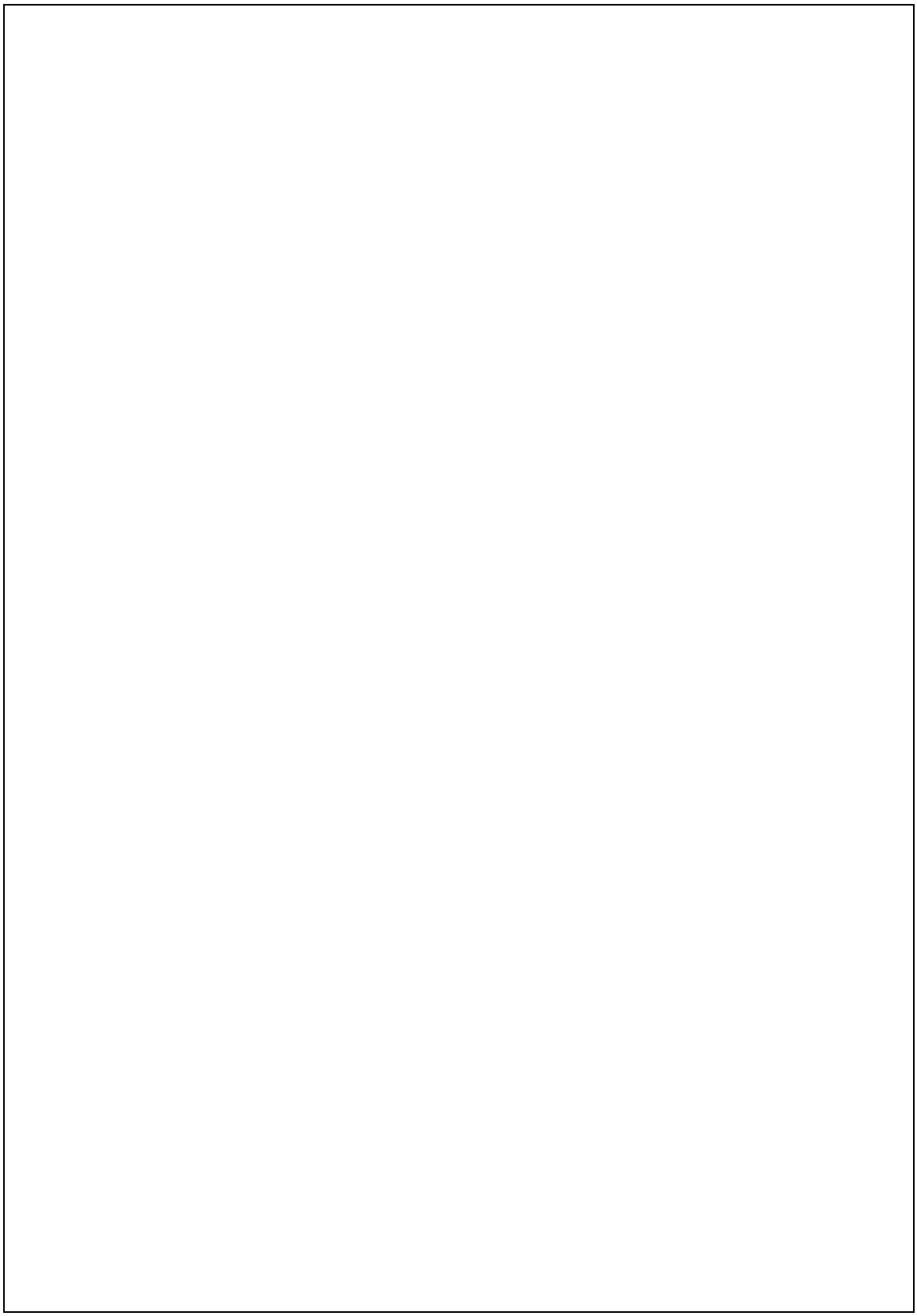
Figure 7.6: N_2O-emissions per km^2 for EUROPE



*) Croatia not yet available

Again the differences are much larger if individual countries are compared: the largest N_2O-emissions per km^2 were for Greece (1 555 kg/km^2) and the next largest ones for Belgium, Flemish region (926 kg/km^2), Belgium, Wallonie region (810 kg/km^2) and Czech Republic (789 kg/km^2). The smallest emissions per km^2 for N_2O were for Norway (48 kg/km^2), Sweden (73 kg/km^2) and Finland (94 kg/km^2). Figure 7.7 shows the countries ranked according their N_2O-emission per km^2. The differences in the emissions per km^2 between countries are much larger compared to the per capita emissions. The smallest number being 32 times smaller than the largest number.

Figure 7.7: N_2O-emissions per km^2 for individual countries



*) Croatia not yet available

Table 7.1: Nitrous oxide emissions per country and group

8. AMMONIA - NH_3

8.1 NH_3-emissions by countries

The 1990 annual total NH_3-emissions for EUROPE were estimated to be 5.7 million tonnes. These emissions broken down by EU-12, EFTA-5 and PHARE-10 countries are shown in figure 8.1. The largest contributor were the EU-12 countries with 63%, second largest the PHARE-10 countries with 28%; the EFTA-5 countries contributed 6% and Germany (former East) and Malta 3%.

Figure 8.1: Contribution in % to the European total NH_3-emissions

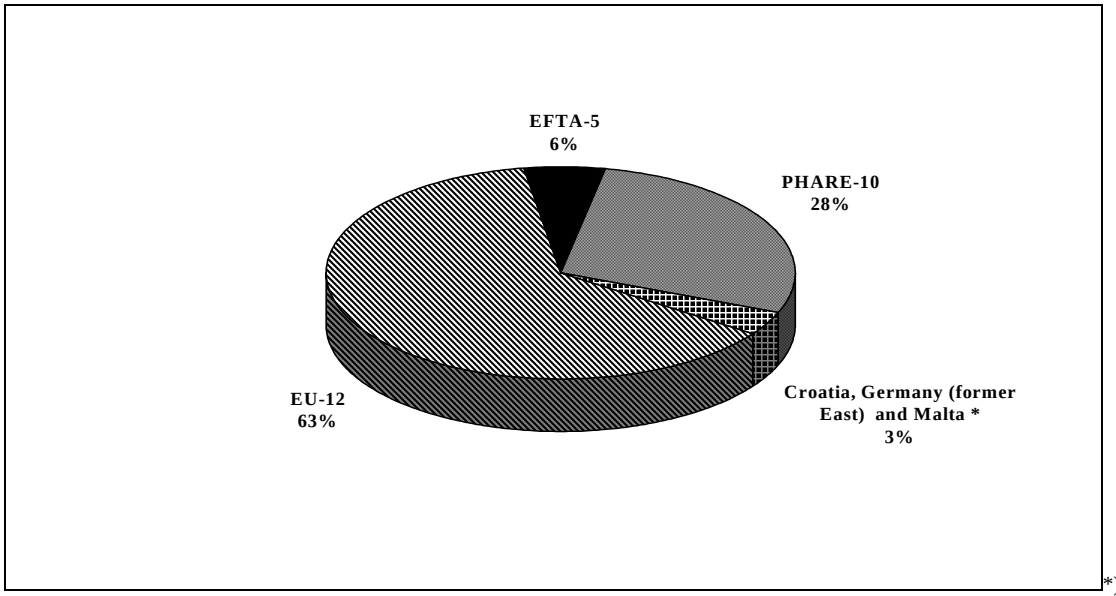


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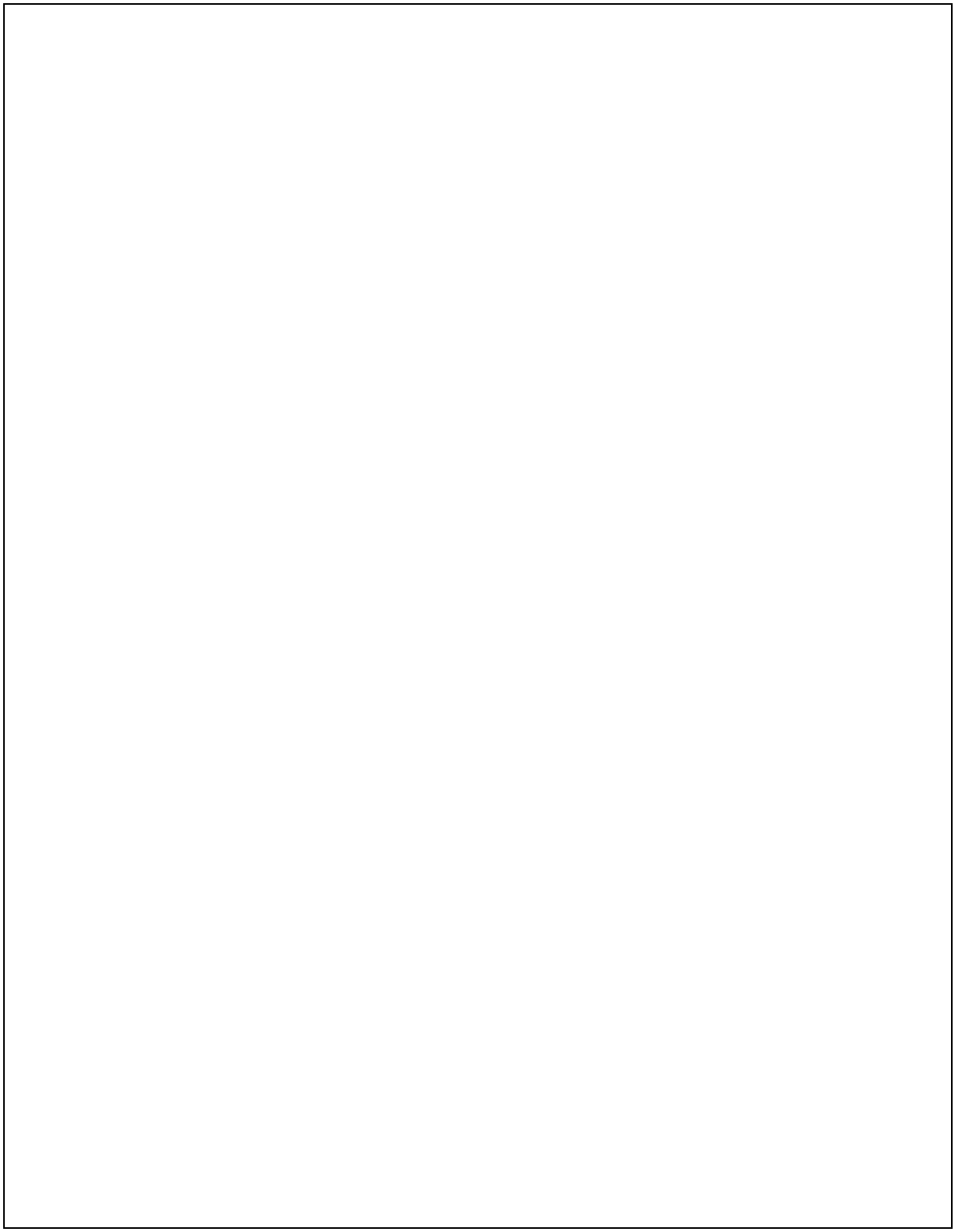
Figure 8.2 shows the relative contribution of individual countries to the total of 5.7 million tonnes. In 1990 the largest contributing countries were France (12%), Poland (10%) and Germany (former West 10%); the smallest contributing countries were Malta (0.10%), Luxembourg (0.1%) and Slovenia (0.5%). These differences are due to different size of population, different per capita emissions (see also paragraph 8.3) and differences in emissions from natural sources**.**

Figure 8.2: Contribution in % of each country to the EUROPEAN total NH_3-emissions



*) Croatia not yet available

8.2 NH_3-emissions per group

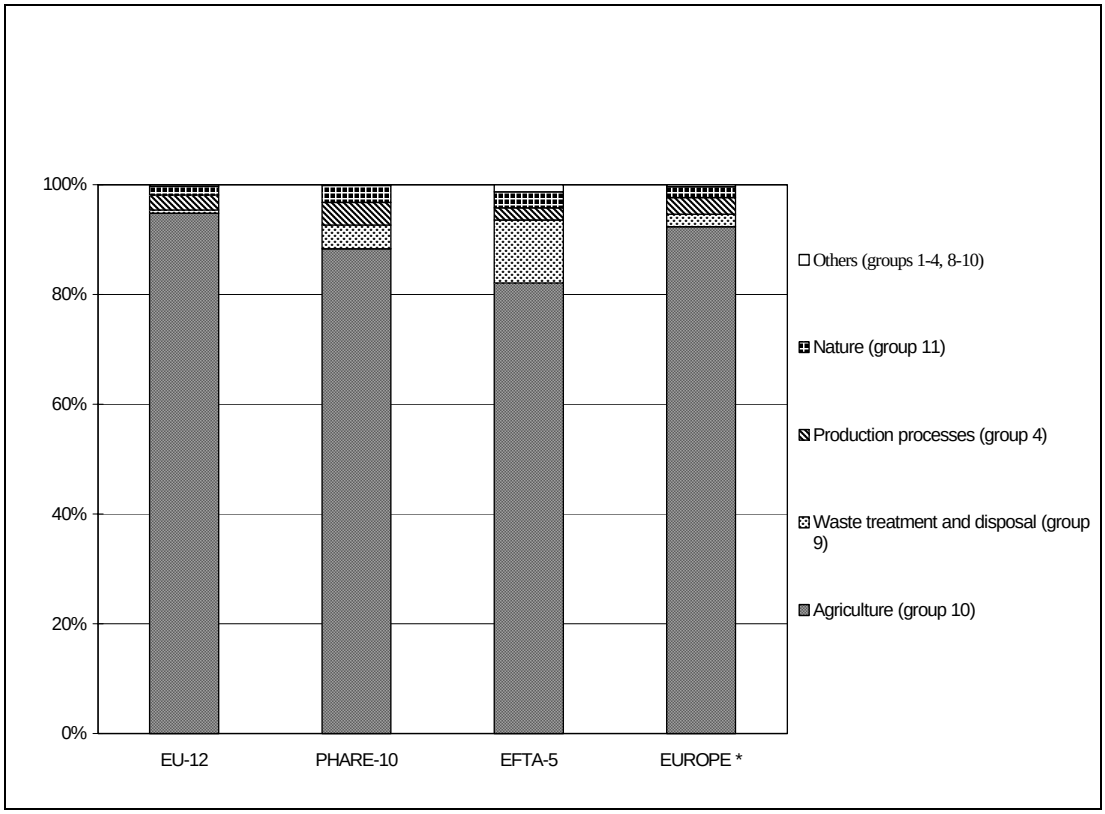
More than 90% of the NH_3-emissions for EUROPE resulted from agriculture (group 10) in 1990. Group 4 (production processes) contributed with 3% and both group 9 (waste treatment and disposal) and group 11 (nature) each produced 2% of the total NH_3-emissions of EUROPE. All other groups were not relevant for NH_3-emissions.

The split of the NH_3-emissions into groups for EU-12 countries, PHARE-10 countries and EFTA-5 countries is quite similar compared to the split for EUROPE with the exception of the larger contribution of group 9 (waste treatment and disposal) with 12% in the EFTA-5 countries and of the smaller contribution of group 10 (agriculture) with 82% in the EFTA-5 countries and with 88% in the PHARE-10 countries.

The differences of contributions especially of the main source group 10 to the total emissions are larger between countries than these groups (see also table 8.1). The relative contribution of the NH_3-emissions of group 10 ranges from 100% (Malta and others) to 60% (Sweden).

It is intended to explain these significant differences in a special NH_3-report. However it is evident already from these differences in the relative contribution of sourcegroups to a countries total emissions that strategies for reduction of NH_3-emissions will need individual solutions as well as common elements.

Figure 8.3: Contribution in % of source groups to the EUROPEAN NH_3-emissions



*) Croatia not yet available

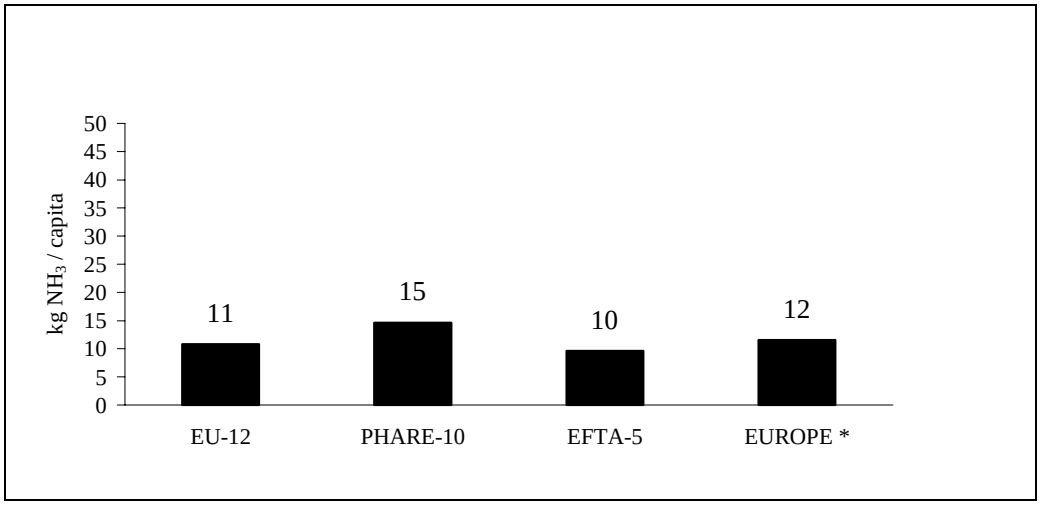
8.3 NH_3-emissions per capita

Only anthropogenic emissions are expected to be related to population for these calculations. Therefore group 11 (nature) has been excluded.

For EUROPE the average NH_3-emissions per capita were 12 kg/capita. Compared to this number the per capita NH_3-emissions were smaller for the EU-12 countries with 11 kg/capita and the EFTA-5 countries with 10 kg/capita and larger for the
PHARE-10 countries with 15 kg/capita. This comparison is also shown in figure 8.4 and table 9.

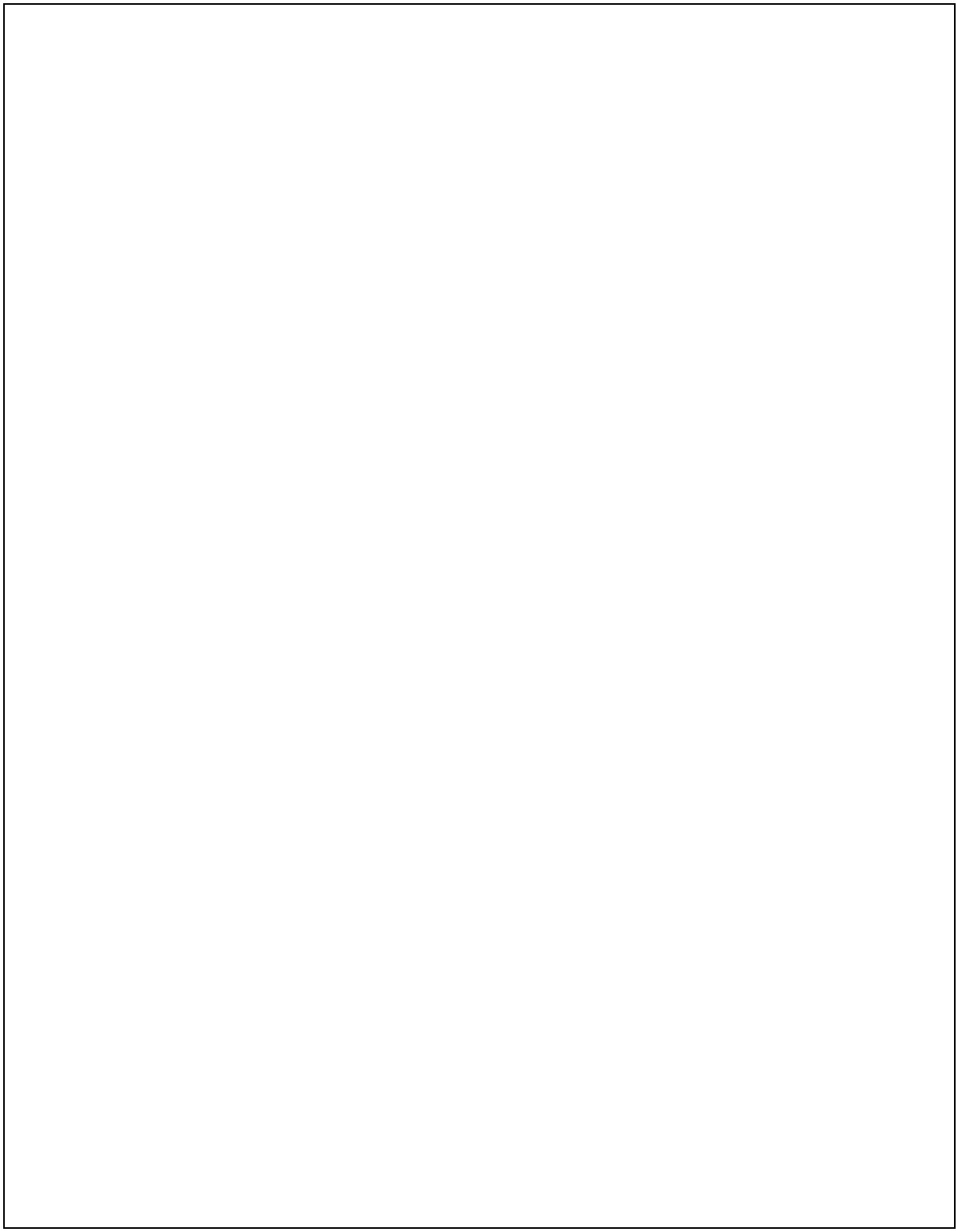
Again the differences are much larger if individual countries are compared. The largest NH_3-emissions per capita were estimated for Greece (47 kg/capita) and Ireland and Bulgaria (each 36 kg/capita); the smallest per capita emissions for NH_3 were calculated for Hungary (6 kg/capita), Italy (7 kg/capita) and Finland, Belgium (Flemish region) and the United Kingdom (each 8 kg/capita). Figure 8.5 shows the countries ranked according their per capita emissions. The smallest per capita emissions is a factor of 8 smaller compared to the largest number.

Figure 8.4: NH_3-emissions per capita for EUROPE



*) Croatia not yet available

Figure 8.5: NH_3-emissions per capita for individual countries



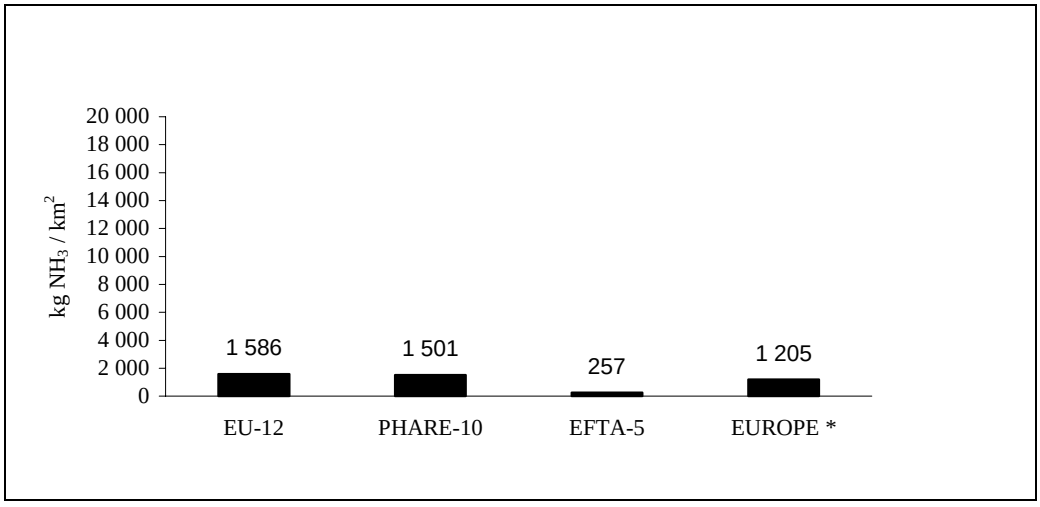
*) Croatia not yet available

8.4 NH_3-emissions per km^2

The emissions per km^2 have been calculated from the total emissions, the emissions of group 11 (nature) having been included in this case.

For EUROPE the average NH_3-emissions per km^2 were estimated as 1 205 kg/km^2. Compared to this number the per km^2 NH_3-emissions were 32% larger for the EU-12 countries with 1 586 kg/km^2, 25% larger for the PHARE-10 countries with 1 501 kg/km^2 and 79% smaller for the EFTA-5 countries with 257 kg/km^2. This comparison is also shown in figure 8.6 and table 10.

Figure 8.6: NH3-emissions per km2 for EUROPE



*) Croatia not yet available

Again the differences are much larger if individual countries are compared: the largest NH_3-emissions per km^2 were for Malta (17 364 kg/km^2) and the next largest ones for the Netherlands (4 930 kg/km^2) and Belgium, Flemish region (3 601 kg/km^2); the smallest emissions per km^2 for NH_3 were for Norway (118 kg/km^2), Finland (121 kg/km^2) and Sweden (164 kg/km^2). Figure 8.7 shows the countries ranked according their NH_3-emission per km^2. The differences in the emissions per km^2 between countries are much larger compared to the per capita emissions. The smallest number being 147 times smaller than

the largest number. Another report will investigate the local differences in emissions per km^2 in more detail.

Figure 8.7: NH_3-emissions per km^2 for individual countries

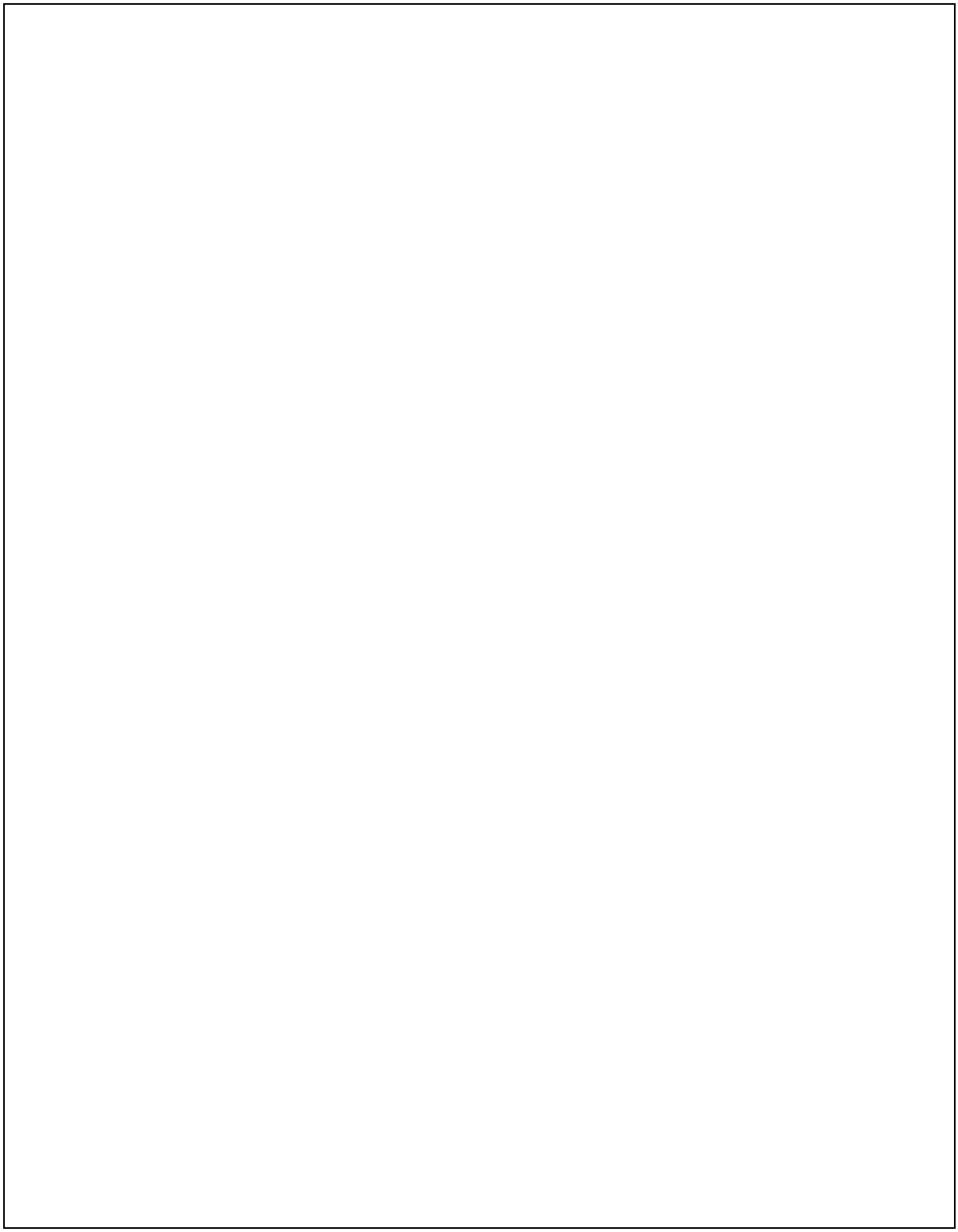


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Table 8.1: Ammonia emissions per country and group

Table 9: Emissions in kg per capita

Table 10: Emissions in kg per km^2

Legend to tables 1.1 - 10

Summary tables Croatia