UNITED NATIONS

Framework Convention on Climate Change

Distr.
GENERAL

FCCC/SBSTA/1999/INF.4
11 May 1999

ENGLISH ONLY

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE
Tenth session
Bonn, 31 May -11 June 1998
Item 5 (b) of the provisional agenda

METHODOLOGICAL ISSUES

EMISSIONS RESULTING FROM FUEL USED FOR INTERNATIONAL TRANSPORTATION

Note by the secretariat

CONTENTS

I. INTRODUCTION

A. Mandate

1. The Subsidiary Body for Scientific and Technological Advice (SBSTA), at its ninth session, requested the secretariat to provide information to the SBSTA, at its tenth session, on emissions resulting from fuel sold to ships or aircraft engaged in international transport, taking into account the ongoing work of the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO). It took note of the information provided by ICAO and requested the secretariat to invite representatives of ICAO and IMO to report on their work to the SBSTA at its tenth session (FCCC/SBSTA/1998/9, para. 51 (i)).

B. Scope of the note

2. This note has been prepared in response to the above mandate. It contains background information on previous intergovernmental considerations, the definition of international bunker fuels and on gases emitted from use of international bunker fuels. It considers information provided by international organizations, particularly the Intergovernmental Panel on Climate Change (IPCC), ICAO and IMO. Finally, it provides information on the current reporting of Parties in national communications and annual inventory reports. The data in this note provide a factual basis for further considerations.

3. Other documents containing information related to emissions from international bunker fuels are documents FCCC/SBSTA/1996/9/Add.1 on methodological issues and FCCC/SBSTA/1996/9/Add.2 containing detailed information on electricity trade and international bunker fuels. In addition, Parties may consider the IPCC Special Report on Aviation and the Global Atmosphere, which is to be made available at the tenth session of the SBSTA.

C. Possible action by the SBSTA

4. The SBSTA may wish to consider the information in this note to develop an approach for further elaborating on decision 2/CP.3 (FCCC/CP/1997/7/Add.1) and Article 2.2 of the Kyoto Protocol, to identify additional information needed and to provide guidance on the content and timing of preparatory work needed for future sessions, taking into account the work of IPCC, ICAO and IMO.

II. BACKGROUND INFORMATION

A. Previous intergovernmental considerations

5. The Revised Guidelines for the Preparation of National Communications by Parties included in Annex I to the Convention as adopted by the Conference of the Parties state that "in providing information on emissions from international aviation and marine bunker fuels, and in accordance with the IPCC Guidelines for National Greenhouse Gas Inventories, Parties should include such data, in a separate category, in their inventories of emissions on the basis of fuel sold and should, as far as possible, not include them in total national emissions" (FCCC/CP/1996/15/Add.1, annex to decision 9/CP.2, para. 17).

6. The SBSTA elaborated on the issue of international bunker fuels at its fourth session and "noted that there are three separate issues related to international bunker fuels: adequate and consistent inventories, allocation of emissions and control options. Appropriate allocation of responsibility for emissions from international bunker fuels would be connected to inventory and control issues. The SBSTA noted that eight options for allocation of bunker fuels were suggested in document FCCC/SBSTA/1996/9/Add.1, and considered that options 1, 3, 4, 5 and 6 should be the basis for its further work on the issue. With respect to option 1, it should be considered to recognize the responsibilities of the international community to address issues related to international bunker fuels. The SBSTA took note of the work of the International Civil Aviation Organization (ICAO), as well as the work of the Annex I expert group on policies and measures to address these emissions. The SBSTA noted the role of ICAO and the International Maritime Organization (IMO) in addressing the control of international bunker fuel emissions, and the opportunity for Parties to work through these bodies. The SBSTA encouraged Parties to report emissions from international aviation and marine bunker fuels as two separate entries in their national communications, in accordance with the revised 1996 IPCC guidelines" (FCCC/SBSTA/1996/20, para. 55).

7. Since the fourth session of the SBSTA, the adoption of the Kyoto Protocol introduced new elements that may affect further consideration of the issue of bunker fuels. These include the concept of a differentiated commitment based on assigned amounts for a particular period, the introduction of different base years, for example for HFCs, PFCs and SF_6, and the provisions of mechanisms such as emissions trading.

8. In particular, Article 2.2 of the Kyoto Protocol states that "the Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organization and the International Maritime Organization, respectively."

9. In addition, the Conference of the Parties (COP), in its decision 2/CP.3, recalled that, under the Revised 1996 Guidelines for National Greenhouse Gas Inventories of the Intergovernmental Panel on Climate Change, emissions based upon fuel sold to ships or aircraft

engaged in international transport should not be included in national totals, but reported separately; and urged the Subsidiary Body for Scientific and Technological Advice to further elaborate on the inclusion of these emissions in the overall greenhouse gas inventories of Parties (FCCC/CP/1997/7/Add.1).[1]

B. Definition of international bunker fuels

10. The term "international bunker fuels" refers in this paper to fuels used for international civil aviation or by seagoing ships engaged in international transport. The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, referred to below as "the IPCC Guidelines", provide separate categories for emissions from international bunker fuels from the aviation and marine sectors.[2] These categories do not include international road transport. Emissions from international road transport are not reported in a separate category and, hence, are allocated to the Party where fuel is sold. Furthermore, it may be noted that the terms "international bunkers", "bunker fuels", or "bunkers" historically refer to marine fuels, but in the context of greenhouse gas inventories are generally used to denote the international share of fuel sold to ships and aircraft.

11. According to the IPCC Guidelines, emissions from these fuels should be estimated on the basis of fuels *sold*, that is, fuel taken on board by each departing aircraft or vessel. It should be distinct from emissions resulting from fuel *consumed* during a journey. The fuel intake of an aircraft, for example, does not necessarily take place in the country of departure. Since carrying excess fuel increases the weight of the aircraft and hence the amount of fuel required to reach the next airport, aircraft on long-haul flights usually only take on the amount of fuel required to reach the next airport. On shorter flights, aircraft may carry sufficient fuel for several stops, depending upon fuel prices, availability and other considerations.

12. Furthermore, complex relationships may exist in the shipping as well as in the aviation sector. These may affect data on fuel use. A ship, for example, may be owned by a company in one country, which itself is owned by other companies in another country, registered in a third country, operated by a ship-management company in a fourth country and crewed from a manning agency in a fifth country with nationals from other countries. Furthermore, carriage may be paid for by charterers, and in some cases a number of sub-charterers, based in other countries.

---

[1] It would be up to the Parties to determine whether, and if so when, the inclusion of international bunker fuels into national totals would affect "assigned amounts" as defined in Article 3 of the Kyoto Protocol. If emissions from international bunker fuels were included in the base year and the "assigned amounts" of Parties, and if bunker emissions were to increase faster or decrease slower than the emissions from other sources, it would make it more difficult for Parties to meet their commitment under the Kyoto Protocol. Conversely, if bunker emissions were to increase slower or decrease faster than the emissions from other sources, it would make it easier for Parties to meet their commitment under the Kyoto Protocol.

[2] IPCC source category 1A3a-i for international aviation bunkers and 1A3d-i for international marine bunkers.

C. Gases emitted from the use of bunker fuels

13. "Aircraft emit gases and particles directly into the upper troposphere and lower stratosphere where they have an impact on atmospheric composition. These gases and particles alter the concentration of atmospheric greenhouse gases, including carbon dioxide (CO_2), ozone (O_3) and methane (CH_4); trigger formation of condensation trails (contrails); and may increase cirrus cloudiness - all of which contribute to climate change."[3]

14. "The principal emissions of aircraft include the greenhouse gases carbon dioxide and water vapor (H_2O). Other major emissions are nitric oxide (NO) and nitrogen dioxide (NO_2) (which together are termed NO_x), sulfur oxides (SO_x), and soot. The total amount of aviation fuel burned, as well as the total emissions of carbon dioxide, NO_x, and water vapor by aircraft, are well known relative to other parameters important to this assessment."

15. The gases emitted from shipping include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), as well as carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOCs) and sulphur oxides (SO_x). CO_2 is the major contributor, while the global warming impact imposed by NO_x from shipping is considered to be small.

16. For additional information regarding the aviation and maritime sector, please refer to document FCCC/SBSTA/1996/9/Add.2.

III. CURRENT INTERNATIONAL WORK

A. Intergovernmental Panel on Climate Change (IPCC)

17. The IPCC Special Report on Aviation and the Global Atmosphere provides an assessment of the effects of aircraft on the climate and atmospheric ozone. It contains information on the impact and projected growth of emissions as well as options to limit or reduce them. The following paragraphs present some of its findings.

18. "The best estimate of the radiative forcing in 1992 by aircraft is 0.05 Wm^{-2} or about 3.5 per cent of the total radiative forcing by all anthropogenic activities. For the reference scenario (Fa1), the radiative forcing by aircraft in 2050 is 0.19 Wm^{-2} or 5 per cent of the radiative forcing in the mid-range IS92a scenario (3.8 times the value in 1992)."

19. While the effects of CO_2 emissions from aircraft are indistinguishable from the same quantity of CO_2 emitted by any other source, other emissions from aircraft have a greater effect on the climate due to emissions at high altitudes. "Over the period from 1992 to 2050, the overall radiative forcing by aircraft (excluding that from change of cirrus clouds) for all scenarios

---

[3] See IPCC Special Report on Aviation and the Global Atmosphere. Quotations in paragraphs 14, 18 and 19 are from the same source.

of this report is a factor 2 to 4 larger than the forcing by aircraft carbon dioxide alone. The overall radiative forcing for the sum of all human activities is estimated to be at most a factor of 1.5 larger than that of carbon dioxide alone."

20. The information provided on options to reduce emissions and impacts includes aircraft and engine technology options, fuel options, operational options, and regulatory and economic options, which consist of engine emissions certification, market-based options such as environmental levies (charges and taxes) and emissions trading, as well as voluntary agreements.

B. International Civil Aviation Organization (ICAO)

21. The 32nd session of the ICAO Assembly (22 September to 2 October 1998) underlined the importance of the Kyoto Protocol and, in a resolution, requested the Council of ICAO to study policy options to limit or reduce the greenhouse gas emissions from civil aviation, taking into account the findings of the IPCC Special Report on Aviation and the Global Atmosphere and the requirements of the Kyoto Protocol, and to report to the next ordinary session of the Assembly in September/October 2001.

22. The work of ICAO related to greenhouse gas emissions falls into three categories: technology and standards, including improved engine or airframe design; operational measures, such as more direct routings through satellite-based communication, navigation, surveillance and air traffic management (CNS/ATM) systems; and market-based options such as emission-related levies (charges or taxes) and emissions trading.

23. Further, the ICAO Assembly considered how ICAO might be able to contribute to an elaboration on decision 2/CP.3. It agreed on the need for continued co-operation with the secretariat of the UNFCCC on this issue, and endorsed further immediate work by ICAO on the effects of the various options that have been suggested by the SBSTA. Such activities would be in close liaison with SBSTA to make proposals for a suitable methodology for allocation.

C. International Maritime Organization (IMO)

24. The Marine Environment Protection Committee (MEPC) of IMO, at its 42nd session (2 to 6 November 1998), agreed to invite the secretariat of IMO to undertake a study concerning greenhouse gas emissions from ships. It will include the current status of greenhouse gas emissions from ships, as well as short- and long-term measures for the reduction of emissions. The report will be available for the 44th session of the MEPC in March 2000. The outcome of the study will form the basis for the MEPC's considerations and development of a policy document on greenhouse gas emissions from ships, which should be forwarded to the secretariat of the UNFCCC.

IV. CURRENT REPORTING IN NATIONAL COMMUNICATIONS AND ANNUAL INVENTORY REPORTS

25. This section provides the estimates of international bunker fuel emissions of Parties on the basis of the latest inventory submissions to the secretariat at the date of preparation of this document. Information from either annual inventory reports or, where not available, second national communications was used. It also includes a preliminary analysis of the methods and data used by Parties for the estimation of these emissions.

A. Emission estimates reported by Parties

26. For the 25 Annex I Parties which reported CO_2 emissions from international bunker fuels for 1990 separately, these emissions account for 2.5 per cent and 2.7 per cent of their total CO_2 emissions[4] in 1990 and 1994 respectively. For the 19 Annex I Parties which reported CO_2 emissions from the marine and aviation sectors separately, emissions from international aviation bunkers accounted for 1.2 per cent, and emissions from international marine bunkers for 1.9 per cent of total CO_2 emissions.

27. Of the 25 Parties that reported CO_2 emissions from international bunker fuels separately, international bunker fuel emissions increased from 1990 to the last year reported (1994, 1995, 1996, or 1997) for 22 Parties. An increase of over 50 per cent was reported by four Parties. The share of CO_2 emissions from international bunker fuels in relation to total national CO_2 emissions (excluding emissions from land-use change and forestry) of individual Parties in 1990 generally ranged around 5 per cent and for some Parties up to 25 per cent. From 1990 to the last year reported (1994, 1995, 1996, or 1997), this share increased for 18 Parties and decreased for seven Parties. Hence, under the assumption that these emissions were to be included in national totals, this inclusion would affect the trend in CO_2 emissions upwards, for 18 Parties, by an average of 0.7 percentage points, and downwards, for seven Parties, by an average of -0.4 percentage points. The effect on the trend is small for those Parties whose emissions from international bunker fuels are small and/or whose trend of international bunker fuel emissions is similar to that of total emissions.

28. Table 1 shows the number of Parties which reported emissions from international bunker fuels separately. The total number of Annex I Parties considered is 37. The two Parties which reported that these emissions are negligible were not included in counting the reporting Parties. Table 2 presents the CO_2 emissions from international bunker fuels, 1990-1997, in gigagrams and percentage of 1990 levels. Tables 3 and 4 present the emissions of CO_2, CH_4, N_2O, CO, NO_x, NMVOCs and SO_2 from international bunker fuels, 1990. Table 5 presents the percentage share of CO_2 emissions from international bunker fuels in relation to total national CO_2 emissions (excluding land-use change and forestry). Table 7 shows the trend in total CO_2

---

[4] Total CO_2 emissions exclude emissions from international bunker fuels.

emissions and the trend including international bunker fuels, as a percentage of the respective 1990 levels, as well as the difference in these trends for the last reported year in percentage points, all estimates excluding land-use change and forestry.

Table 1. Number of Parties which reported emissions from international bunker fuels separately for 1990[5]

Gas	Emissions from international bunker fuels		Aviation and marine separate	
	Number of Parties	Percentage	Number of Parties	Percentage
CO_2	25	68	19	51
CH_4	21	57	16	43
N_2O	20	54	14	38
CO	18	49	14	38
NO_x	19	51	14	38
NMVOCs	18	49	14	38
SO_2	10	27	8	22

B. Methods and data used by Parties to estimate emissions from international bunker fuels

29. This section presents the findings of a study undertaken by the secretariat, with the assistance of a consultant, to identify and assess the procedures for data collection, methods used to estimate emissions, and barriers which prevent consistent reporting.

30. The preliminary analysis suggests that the major barriers to reporting emissions from international bunker fuels consistently include: availability of data to make the required split between domestic and international; consistent use of definitions of domestic and international; and consistent use of methods to estimate the emissions.

31. For some Parties, the distinction between domestic and international is not given in national energy statistics. Hence, several Parties were not in a position to report emissions from international bunker fuels separately (tables 1 and 2) or employed different definitions regarding the international share of emissions from ships and aircraft.

32. For example, Hungary and Ireland consider all emissions from fuel sold to ships and aircraft as international. Further, Norway reports difficulties in isolating domestic from international data for airline companies with extensive national and international traffic via other

[5] The total number of Annex I Parties considered is 37. The two Parties which reported that these emissions are negligible, were not included in counting the reporting Parties. Parties which are landlocked nations and do not have marine bunkers were included in counting the Parties that reported aviation and marine separately.

Nordic countries. Germany assumes 20 per cent of the air traffic to be domestic and is currently undertaking a research project to corroborate this assumption. Canada considers all emissions which are based on fuel sold to foreign registered vessels and aircraft as international. Other Parties report difficulties in reporting these emissions separately.

33. The implications of the use of different definitions in terms of emissions is difficult to estimate with the data available at present. The split between domestic and international emissions for reporting Parties may give an indication of the implications of the use of different definitions. Table 6 presents domestic and international CO_2 emissions from transport and the share of each in 1990 for selected Parties which reported international emissions separately and emissions of domestic transport in sufficient detail. The limited data suggest that for countries with a small area, the domestic share of the emissions is rather low (Belgium) whereas in countries with a large area, the domestic share is rather high (Canada).

34. The data currently collected by some Parties is based on fuel sold to ships and aircraft engaged in international transport, as required by the IPCC Guidelines. Some Parties also collect data on the amount of fuel sold to foreign registered companies. Additional data which could be relevant include the amount of fuel sold to foreign registered transport companies, aircraft, ships or operators, and countries of departure and destination for all journeys of all ships and aircraft and of all passengers and cargo engaged in international transport. These data could be derived from global flight schedules, which are limited to scheduled flights, or global sales databases for marine fuels. These sources of data are currently not available to the secretariat. If these data are not available elsewhere, it might take Parties three to five years to put in place systems to collect and report such information in a consistent manner. The cost of additional data collection cannot be determined by the secretariat. If Parties were to collect such data, the reporting format for these emissions and the guidelines for the preparation of national communications (including part I of the reporting guidelines on inventories) would possibly need further modifications.

Table 2. CO_2 emissions from international bunker fuels, 1990-1997 (Gigagrams and percentage relative to 1990, 1990=100)

	1990 (Gg)	1991 (Gg)	(%)	1992 (Gg)	(%)	1993 (Gg)	(%)	1994 (Gg)	(%)	1995 (Gg)	(%)	1996 (Gg)	(%)	1997 (Gg)	(%)
Australia	6 401	6 379	**100**	6 584	**103**	6 988	**109**	7 240	**113**	8 533	**133**	9 031	**141**		
Austria[a]	890	1 040	**117**	1 110	**125**	1 080	**121**	1 140	**128**	1 220	**137**	1 380	**155**		
Belgium	15 726	15 980	**102**	16 738	**106**	16 770	**107**	16 021	**102**	15 556	**99**	18 308	**116**		
Bulgaria[b]	162	878	**541**	873	**538**	844	**520**	850	**523**	882	**543**				
Canada	4 920	4 610	**94**	4 640	**94**	4 290	**87**	4 540	**92**	4 710	**96**	5 170	**105**		
Czech Republic												459			
Denmark	4 986	4 507	**90**	4 677	**94**	6 041	**121**	6 736	**135**	7 080	**142**	6 970	**140**		
Estonia[c]															
Finland	2 800			3 000	**107**	2 500	**89**	2 120	**76**	1 800	**64**	2 100	**75**	2 300	**82**
France	15 488	15 846	**102**	16 827	**109**	17 037	**110**	16 639	**107**	17 329	**112**	18 154	**117**		
Germany	19 569	18 102	**93**	17 818	**91**	19 917	**102**	19 874	**102**	19 874	**102**	19 874	**102**		
Greece	10 423	9 446	**91**	10 610	**102**	12 711	**122**	13 203	**127**	13 812	**133**	12 432	**119**		
Hungary[ad]		376	**100**	386	**103**	361	**96**	532	**141**	524	**139**	560	**149**		
Iceland	319	260	**82**	264	**83**	293	**92**	307	**96**	377	**118**				
Ireland	1 172	1 316	**112**	1 124	**96**	1 546	**132**	1 350	**115**	1 510	**129**	1 605	**137**		
Italy	12 204							12 416	**102**	13 099	**107**				
Japan	30 806	33 036	**107**	34 095	**111**	36 688	**119**	37 494	**122**	37 328	**121**	32 420	**105**		
Latvia[c]															
Liechtenstein[c]															
Lithuania[c]															
Luxembourg[a]	111							194	**175**	194	**175**				
Monaco[e]															
Netherlands	40 400	41 700	**103**	42 700	**106**	44 600	**110**	43 200	**107**	44 600	**110**	45 800	**113**		
New Zealand	2 384	2 205	**92**	2 189	**92**	2 256	**95**	2 768	**116**	2 708	**114**	2 580	**108**		
Norway	1 988	1 786	**90**	2 130	**107**	2 334	**117**	2 402	**121**	2 828	**142**	3 112	**157**		
Poland												2 068			
Portugal	2 062	2 068	**100**	2 133	**103**	1 848	**90**	1 850	**90**						
Romania[c]															
Russian Federation	12 400							10 000	**81**						
Slovakia[e]															
Slovenia[c]															
Spain[f]	18 024	18 824	**104**	19 496	**108**	17 875	**99**	19 144	**106**						
Sweden	4 207	4 331	**103**	4 816	**114**	4 855	**115**	5 400	**128**	5 367	**128**	4 899	**116**		
Switzerland[a]	2 160	2 200	**102**	2 240	**104**	2 290	**106**	2 330	**108**	2 430	**113**	2 500	**116**		
Ukraine[c]															
United Kingdom	21 349	20 909	**98**	22 761	**107**	23 814	**112**	24 243	**114**	26 086	**122**	28 163	**132**		
United States	83 400	87 800	**105**	91 300	**109**	83 800	**100**	81 700	**98**	86 700	**104**	82 400	**99**		

[a] Party is landlocked and does not have marine bunkers.
[b] 1990 column contains values for 1988, the base year for Bulgaria. The percentages are related to the base year 1988.
[c] Party did not provide estimates for international bunker fuels.
[d] Party did not provide estimate for 1990. The percentages are related to the year 1991.
[e] Party did not provide estimates for international bunker fuels, but indicated that emissions were negligible.
[f] Party did not provide estimates for international bunker fuels in 1998 inventory submission. Values are taken from second national communication.

Table 3. Emissions of CO_2, CH_4 and N_2O from international bunker fuels, 1990 (Gigagrams)

	CO_2			CH_4			N_2O		
	Aviation (Gg)	**Marine (Gg)**	**Total (Gg)**	**Aviation (Gg)**	**Marine (Gg)**	**Total (Gg)**	**Aviation (Gg)**	**Marine (Gg)**	**Total (Gg)**
Australia	4 345	2 056	6 401	0.01	0.69	0.70	0.13	0.06	0.19
Austria[a]	890		890	0.00		0.00	0.01		0.01
Belgium	2 370	13 356	15 726						
Bulgaria[b]			162			0.00			0.00
Canada	2 860	2 070	4 920	0.10	0.10	0.10	0.30	0.30	0.60
Czech Republic[c]									
Denmark			4 986			0.00			0.00
Estonia[c]									
Finland			2 800			1.30			1.20
France	7 351	8 136	15 488	0.00	0.00	0.00	0.00	0.26	0.26
Germany	11 589	7 980	19 569	0.20	0.30	0.50	0.20	0.40	0.60
Greece	2 452	7 971	10 423	0.40	0.80	1.20	0.10	0.50	0.60
Hungary[c]									
Iceland			319			0.00			0.00
Ireland			1 172			0.00			0.00
Italy	3 737	8 467	12 204	0.30	0.80	1.10	0.10	0.50	0.60
Japan	13 184	17 621	30 806	0.37	1.31	1.68	0.00	0.37	0.37
Latvia[c]									
Liechtenstein[c]									
Lithuania[c]									
Luxembourg[a]	111		111	0.00		0.00	0.00		0.00
Monaco[d]									
Netherlands	4 500	35 900	40 400						
New Zealand	1 353	1 031	2 384	0.03	0.10	0.13	0.02	0.03	0.05
Norway	510	1 478	1 988	0.00	0.11	0.11	0.02	0.04	0.05
Poland[c]									
Portugal	888	1 173	2 062	0.23	1.86	2.08	0.01	0.03	0.04
Romania[c]									
Russian Federation	2 900	9 500	12 400	0.02	0.63	0.65	0.08	0.08	0.16
Slovakia[d]									
Slovenia[c]									
Spain[e]	5 948	12 076	18 024	1.47	0.55	2.03		0.30	0.30
Sweden	2 045	2 162	4 207	0.10		0.10			
Switzerland[a]	2 160		2 160						
Ukraine[c]									
United Kingdom	14 791	6 559	21 349	2.85	0.60	3.46	0.45	0.42	0.87
United States			83 400						

Note: Estimates of aviation and marine may not add up to the total due to rounding.

[a] Party is landlocked and does not have marine bunkers.
[b] 1990 column contains values for 1988, the base year for Bulgaria.
[c] Party did not provide estimates for international bunker fuels for 1990.
[d] Party did not provide estimates for international bunker fuels, but indicated that emissions were negligible.
[e] Party did not provide estimates for international bunker fuels in 1998 inventory submission. Values are taken from second national communication.

Table 4. Emissions of CO, NO_x, NMVOCs and SO_2 from international bunker fuels, 1990 (Gigagrams)

	CO			NO_x			NMVOCs			SO_2		
	Aviation (Gg)	Marine (Gg)	Total (Gg)	Aviation (Gg)	Marine (Gg)	Total (Gg)	Aviation (Gg)	Marine (Gg)	Total (Gg)	Aviation (Gg)	Marine (Gg)	Total (Gg)
Australia	7.03	1.92	8.95	23.21	54.68	77.90	3.59	1.70	5.29			
Austria[a]	1.54		1.54	4.73		4.73	0.60		0.60	0.29		0.29
Belgium												
Bulgaria[b]			1.80			22.40			0.30			
Canada												
Czech Republic[c]												
Denmark			9.00			85.00			3.00			55.00
Estonia[c]												
Finland						22.00						
France	17.34	2.10	19.44	57.60	154.75	212.35	8.52	70.82	79.34	2.40	150.77	153.17
Germany	56.60	37.30	93.90	50.60	155.30	205.90	9.30	15.20	24.50	3.90	126.30	130.20
Greece	32.50	23.20	55.70	20.40	195.50	215.90	5.80	5.70	11.40	0.80	154.60	155.40
Hungary[c]												
Iceland			0.80			3.20			0.10			0.10
Ireland			2.19			5.35			0.36			
Italy	3.50	20.00	23.50	12.00	194.30	206.30	2.50	5.70	8.20	1.20	131.20	132.40
Japan	22.39	33.59	55.98	54.11	335.86	389.97	3.36	9.70	13.06			
Latvia[c]												
Liechtenstein[c]												
Lithuania[c]												
Luxembourg[a]	0.27		0.27	0.07		0.07	0.09		0.09			
Monaco[d]												
Netherlands												
New Zealand	2.19	2.49	4.67	5.57	24.86	30.43	0.34	0.71	1.05	0.09	9.30	9.39
Norway	1.64	1.44	3.08	1.45	30.26	31.71	0.61	1.11	1.73	0.05	9.90	9.95
Poland[c]												
Portugal	1.72	0.72	2.44	3.51	33.01	36.52	0.03	0.09	0.11			
Romania[c]												
Russian Federation												
Slovakia[d]												
Slovenia[c]												
Spain[e]	9.82	7.19	17.01	23.61	249.26	272.87	0.19	11.24	11.43			
Sweden	3.70	2.50	6.20	4.20	48.00	52.20	0.50	1.00	1.50			
Switzerland[a]												
Ukraine[c]												
United Kingdom	60.06	15.53	75.59	72.79	119.63	192.41	36.87	4.43	41.30	3.76	92.48	96.23
United States												

Note: Estimates of aviation and marine may not add up to the total due to rounding.

[a] Party is landlocked and does not have marine bunkers.
[b] 1990 column contains values for 1988, the base year for Bulgaria.
[c] Party did not provide estimates for international bunker fuels for 1990.
[d] Party did not provide estimates for international bunker fuels, but indicated that emissions were negligible.
[e] Party did not provide estimates for international bunker fuels in 1998 inventory submission. Values are taken from second national communication.

Table 5. Percentage share of CO_2 emissions from international bunker fuels in relation to total CO_2 emissions[a] (excluding emissions from land-use change and forestry), 1990 -1997

	1990 (%)	1991 (%)	1992 (%)	1993 (%)	1994 (%)	1995 (%)	1996 (%)	1997 (%)
Australia	2.3	2.3	2.4	2.5	2.5	2.9	2.9	
Austria[b]	1.4	1.6	1.8	1.8	1.9	1.9	2.1	
Belgium	13.5	13.3	14.1	14.5	13.2	12.8	14.2	
Bulgaria[c]	0.2	1.3	1.5	1.4	1.4	1.4		
Canada	1.1	1.0	1.0	0.9	1.0	1.0	1.0	
Czech Republic							0.3	
Denmark	9.5	7.2	8.1	10.2	10.6	11.9	9.5	
Estonia[d]								
Finland	4.7		5.7	4.7	3.6	3.0	3.2	3.6
France	4.0	3.8	4.1	4.4	4.3	4.4	4.5	
Germany	1.9	1.9	1.9	2.2	2.2	2.2	2.2	
Greece	12.2	11.1	12.2	14.5	14.9	15.3	13.5	
Hungary[b]		0.6	0.6	0.6	0.9	0.9	0.9	
Iceland	14.9	12.6	12.0	12.7	13.6	16.5		
Ireland	3.8	4.2	3.5	4.8	4.1	4.4	4.6	
Italy	2.8				3.0	3.0		
Japan	2.7	2.9	2.9	3.2	3.1	3.1	2.6	
Latvia[d]								
Liechtenstein[d]								
Lithuania[d]								
Luxembourg[b]	0.9				1.6	2.0		
Monaco[e]								
Netherlands	25.0	25.0	25.9	26.6	25.7	25.2	24.8	
New Zealand	9.4	8.5	7.9	8.3	10.2	10.0	8.9	
Norway	5.6	5.3	6.2	6.5	6.4	7.4	7.6	
Poland							0.6	
Portugal	4.4	4.2	4.0	3.7	3.6			
Romania[d]								
Russian Federation	0.5				0.6			
Slovakia[e]								
Slovenia[d]								
Spain[f]	8.0	8.3	8.3	7.9	8.1			
Sweden	7.6	7.8	8.6	8.7	9.2	9.2	7.7	
Switzerland[b]	4.8	4.7	4.9	5.2	5.4	5.5	5.6	
Ukraine[d]								
United Kingdom	3.7	3.6	4.0	4.3	4.4	4.8	5.0	
United States	1.7	1.8	1.8	1.6	1.6	1.7	1.5	

[a] Total CO_2 emissions exclude emissions from international bunker fuels.
[b] Party is landlocked and does not have marine bunkers.
[c] 1990 column contains values for 1988, the base year for Bulgaria.
[d] Party did not provide estimates for international bunker fuels.
[e] Party did not provide estimates for international bunker fuels, but indicated that emissions were negligible.
[f] Party did not provide estimates for international bunker fuels in 1998 inventory submission. Values are taken from second national communication.

Table 6. Domestic and international CO_2 emissions from transport and percentage share of each for selected Parties, 1990

		Domestic	International	Domestic share	International share
		A	B	A/(A+B)*100	B/(A+B)*100
		Gg (CO_2)	Gg (CO_2)	%	%
Australia	aviation	2 555	4 345	37	63
Australia	marine	2 224	2056	52	48
Austria	aviation (1995)	90	1 210	7	93
Belgium	aviation	7	2 370	0.3	99.7
Belgium	marine	378	13 356	3	97
Canada	aviation	10 300	2 860	78	22
Canada	marine	5 720	2 070	73	27
Germany[a]	aviation	2 897	11 589	20	80
Germany	marine	1 396	7 980	15	85
New Zealand	aviation	781	1 353	37	63
New Zealand	marine	221	1 031	18	82
Sweden	aviation	682	2 045	25	75
Sweden	marine	652	2 162	23	77
Switzerland	aviation (1995)	1 245	2 430	34	66

[a] Due to unavailability of data it is assumed that 20 per cent of the emissions are domestic.

Table 7. Trend in total CO_2 emissions[a] and the trend in total CO_2 emissions including international bunker fuels as a percentage of the respective 1990 levels, and difference for the last reported year in percentage points (all estimates excluding land-use change and forestry)

		Percentage relative to 1990, 1990 = 100									
		1990 (Gg)	1991 %	1992 %	1993 %	1994 %	1995 %	1996 %	1997 %	Difference[b] percentage points	
Australia	excl.	275 344	100.6	101.5	102.8	104.2	108.3	112.0		0.7	Australia
	incl.	281 745	100.6	101.5	102.9	104.4	108.9	112.7			
Austria[c]	excl.	62 100	107.6	97.7	96.0	96.6	102.4	104.7		0.7	Austria
	incl.	62 990	107.7	98.1	96.3	97.1	102.9	105.4			
Belgium	excl.	116 090	103.4	101.9	99.8	104.5	104.9	110.7		0.7	Belgium
	incl.	131 816	103.2	102.4	100.6	104.2	104.2	111.4			
Bulgaria[d]	excl.	96 878	68.3	62.1	64.4	61.5	64.2			0.8	Bulgaria
	incl.	97 040	69.1	62.9	65.2	62.2	65.0				
Canada	excl.	460 899	97.9	101.0	101.4	103.5	107.4	110.3		-0.1	Canada
	incl.	465 819	97.9	100.9	101.2	103.3	107.3	110.3			
Czech Republic[e]	excl.	165 490	92.5	84.7	81.5	77.2	77.8	80.1			Czech Republic
	incl.										
Denmark	excl.	52 277	120.4	110.3	113.5	121.2	113.9	140.1		0.0	Denmark
	incl.	57 263	117.8	108.8	114.2	122.4	116.3	140.1			
Estonia[f]	excl.	37 797	97.8	73.5	58.2	60.5	55.2	56.7			Estonia
	incl.										
Finland	excl.	59 200		88.5	89.7	100.1	102.9	112.1	109.1	-1.2	Finland
	incl.	62 000		89.4	89.7	99.0	101.1	110.4	107.9		
France	excl.	390 708	106.8	104.8	99.2	98.9	100.7	104.1		0.5	France
	incl.	406 196	106.6	104.9	99.6	99.2	101.1	104.6			
Germany	excl.	1 014 155	96.2	91.4	90.5	89.2	88.2	89.7		0.2	Germany
	incl.	1 033 724	96.1	91.4	90.8	89.4	88.5	90.0			
Greece	excl.	85 349	99.6	101.9	102.4	104.0	105.8	107.8		1.3	Greece
	incl.	95 772	98.6	101.9	104.6	106.4	108.7	109.0			
Hungary[cg]	excl.		67 391	89.9	90.3	87.8	88.7	89.7		0.3	Hungary
	incl.		67 767	89.9	90.3	88.1	89.0	90.1			
Iceland	excl.	2 147	96.3	102.3	107.2	105.5	106.3			1.5	Iceland
	incl.	2 466	94.4	99.8	105.2	104.3	107.8				
Ireland	excl.	30 719	103.0	105.4	104.0	108.5	111.1	113.3		0.9	Ireland
	incl.	31 891	103.3	105.0	105.0	108.7	111.7	114.2			
Italy	excl.	432 150				95.4	101.2			0.2	Italy
	incl.	444 354				95.6	101.4				
Japan	excl.	1 124 532	102.1	103.4	101.7	108.0	108.5	109.8		-0.1	Japan
	incl.	1 155 338	102.2	103.6	102.2	108.3	108.8	109.7			
Latvia[f]	excl.	24 771	78.4	66.3	58.5	48.1	48.6	44.7			Latvia
	incl.										
Liechtenstein[f]	excl.	208									Liechtenstein
	incl.										
Lithuania[f]	excl.	39 535									Lithuania
	incl.										
Luxembourg[c]	excl.	12 750				94.1	74.9			0.9	Luxembourg
	incl.	12 861				94.8	75.7				

(continued)

		Percentage relative to 1990, 1990 = 100									
		1990 (Gg)	**1991** %	**1992** %	**1993** %	**1994** %	**1995** %	**1996** %	**1997** %	**Difference**[j] percentage points	
Monaco[h]	excl.	108	115.7	123.1	125.0	127.8	125	130.6			Monaco
	incl.										
Netherlands	excl.	161 360	103.4	102.4	103.8	104.4	109.6	114.6		-0.2	Netherlands
	incl.	201 760	103.4	103.0	105.1	104.9	109.8	114.3			
New Zealand	excl.	25 241	102.2	109.8	107.2	107.3	107.1	114.9		-0.6	New Zealand
	incl.	27 625	101.3	108.3	106.1	108.1	107.7	114.3			
Norway	excl.	35 457	95.3	97.1	101.2	106.5	107.5	115.8		2.2	Norway
	incl.	37 445	95.0	97.6	102.1	107.3	109.4	118.0			
Poland[e]	excl.	476 625		78.0		78.0		78.2			Poland
	incl.										
Portugal	excl.	47 123	103.7	112.5	106.6	107.9				-0.8	Portugal
	incl.	49 185	103.6	112.1	105.9	107.1					
Romania[fi]	excl.	194 826	69.6	66.8	65.2	64.5					Romania
	incl.										
Russian Federation	excl.	2 372 300	92.5	84.6	78.2	70.0				0.1	Russian Federation
	incl.	2 384 700				70.0					
Slovakia[hj]	excl.		50039.0	91.2	87.1	80.7	90.6	92.1			Slovakia
	incl.										
Slovenia[f]	excl.	13 935									Slovenia
	incl.										
Spain[k]	excl.	226 423	100.5	103.8	99.9	104.9				0.1	Spain
	incl.	244 447	100.8	104.1	99.8	105.0					
Sweden	excl.	55 445	99.6	101.0	101.0	105.5	104.8	114.3		0.2	Sweden
	incl.	59 652	99.8	102.0	102.0	107.1	106.4	114.4			
Switzerland[c]	excl.	45 070	103.5	100.8	97.6	96.2	98.0	99.8		0.7	Switzerland
	incl.	47 230	103.4	100.9	97.9	96.7	98.7	100.5			
Ukraine[f]	excl.	700 107									Ukraine
	incl.										
United Kingdom	excl.	583 165	100.7	97.9	95.5	94.9	93.2	96.6		1.2	United Kingdom
	incl.	604 514	100.6	98.2	96.1	95.5	94.3	97.9			
United States	excl.	4 943 300	98.9	100.4	102.8	104.5	105.3	109.1		-0.2	United States
	incl.	5 026 700	99.0	100.5	102.7	104.4	105.2	108.9			

Note: "excl." denotes trend in total CO_2 emissions excluding emissions from international bunker fuels.
"incl." denotes trend in total CO_2 emissions including emissions from international bunker fuels.

[a] Total CO_2 emissions exclude emissions from international bunker fuels.
[b] The difference in trend for the last reported year between emissions including and excluding international bunker fuels. Example Australia: 112.7 per cent (incl.) minus 112.0 per cent (excl.) equals 0.7 percentage points. Differences may occur due to rounding (Canada, Germany, Greece, Hungary, Luxembourg, Netherlands, Russian Federation, Sweden, United Kingdom).
[c] Party is landlocked and does not have marine bunkers.
[d] 1990 column contains values for 1988, the base year for Bulgaria. The percentages are related to the base year 1988.
[e] Party provided estimates for international bunker fuels only for 1996.
[f] Party did not provide estimates for international bunker fuels.
[g] Party did not provide estimates for international bunker fuels for 1990. Absolute values in Gg are given in column for 1991. The percentages in the other columns are related to the year 1991.
[h] Party did not provide estimates for international bunker fuels, but indicated that emissions were negligible.
[i] 1990 column contains value for 1989, the base year for Romania. The percentages are related to the base year 1989.
[j] Party did not provide estimates for 1990 in the 1998 inventory submission. Absolute value in Gg is given in column for 1991. The percentages in the other columns are related to the year 1991.
[k] Party did not provide estimates for international bunker fuels in 1998 inventory submission. Values are taken from second national communication.

- - - - -