Climate and Atmosphere

Sources: World Resources Institute, International Energy Agency, United Nations Framework Convention on Climate Change

	Carbon Dioxide (CO_2) Emissions (a)				Cumulative CO_2 Emissions (million metric tons)		CO_2 Emissions by Sector (as a percent of total CO_2 emissions)			Emissions (in million metric tons CO_2 equivalent) of			Total GHG Emissions (c) (million metric tons CO_2 equivalent)	Kyoto Protocol Status (year ratified, n.r. = not ratified) (d)
	Total		Per Capita											
	(million metric tons) 2000	(percent change since 1990)	(metric tons per person) 2000	(percent change since 1990)	From Fossil Fuels & Cement 1950-2000	From Land-Use Change 1950-2000	Trans-portation 2000	Industry & Construc-tion 2000	Elec-tricity 2000	Methane 2000	Nitrous Oxide 2000	Fluori-nated Gases (b) 2000	2000	
World	**23,895.7**	**12.7**	**3.9**	**(2.3)**	**781,501**	**315,122**	**24.1**	**18.5**	**38.3**	**5,948.2**	**3,402.9**	**374.3**	**33,309**	**..**
Asia (excl. Middle East)	**7,837.0**	**35.1**	**2.2**	**17.9**	**175,087**	**163,621**	**13.3**	**24.7**	**40.1**	**2,149.9**	**1,395.9**	**123.3**	**11,471**	**..**
Armenia	3.7	(44.5)	1.2	(36.7)	219	..	13.9	34.2	38.9	2.8	0.3	0.0	7	2003
Azerbaijan	29.5	(39.1)	3.6	(46.3)	1,630	..	5.2	17.2	49.8	11.9	0.8	0.2	42	2000
Bangladesh	29.9	105.6	0.2	63.2	433	(273)	10.8	35.4	31.6	47.6	44.8	0.0	122	2001
Bhutan	0.4	203.1	0.2	150.7	4	0	..	..	..	1.1	0.3	0.0	2	2002
Cambodia	0.5	18.8	0.0	(10.9)	18	1,658	..	..	..	68.0	0.1	0.0	69	2002
China	3,473.6	39.3	2.7	26.2	71,662	38,909	6.9	29.0	41.8	802.9	644.7	45.6	4,942	2002
Georgia	6.2	(35.2)	1.2	(32.7)	321	..	27.3	13.5	27.8	4.4	1.1	0.0	12	1999
India	1,008.0	63.7	1.0	36.3	18,195	(1,191)	12.2	21.8	51.8	445.3	399.0	1.8	1,837	2002
Indonesia	286.0	96.8	1.4	69.4	4,213	75,740	22.7	21.0	22.6	169.2	38.7	0.5	495	2004
Japan	1,224.7	12.3	9.6	9.2	37,155	5,008	21.8	20.3	35.7	21.8	37.0	50.3	1,333	2002 e
Kazakhstan	123.7	(51.7)	7.9	(48.1)	8,469	..	5.4	26.4	47.8	27.3	7.8	0.2	159	n.r.
Korea, Dem People's Rep	168.3	(19.2)	7.6	(27.6)	4,987	313	2.5	61.3	16.4	33.5	6.5	0.2	209	2005
Korea, Rep	470.0	85.4	10.0	69.7	6,971	867	20.2	19.1	32.6	25.0	16.1	14.4	525	2002
Kyrgyzstan	4.8	(55.7)	1.0	(60.4)	362	..	13.3	21.1	41.7	2.2	0.1	0.0	7	2003
Lao People's Dem Rep	0.4	78.8	0.1	39.3	11	698	..	..	..	6.2	0.1	0.0	7	2003
Malaysia	123.6	120.3	5.4	70.9	1,714	20,654	26.2	23.1	25.5	30.4	13.3	0.6	169	2002
Mongolia	7.3	(27.1)	2.9	(35.3)	248	69	..	..	..	8.2	12.1	0.0	28	1999
Myanmar	8.9	108.1	0.2	78.1	217	12,571	37.5	18.8	26.6	61.1	12.5	0.0	82	2003
Nepal	3.2	235.0	0.1	163.5	34	3,648	26.0	35.0	0.6	16.4	11.3	0.0	32	n.r.
Pakistan	106.0	62.7	0.7	26.6	1,833	1,292	24.7	26.2	32.6	94.7	84.6	0.2	285	2005
Philippines	75.3	77.5	1.0	43.4	1,507	2,803	33.5	13.3	32.5	34.2	20.8	0.6	133	2003
Singapore	61.1	103.4	15.2	52.8	913	1	9.8	4.1	39.7	1.2	0.9	0.9	64	n.r.
Sri Lanka	11.2	167.6	0.6	142.3	202	873	52.8	10.1	26.6	13.3	2.9	0.0	28	2002
Tajikistan	4.5	(67.5)	0.7	(71.6)	448	..	46.7	0.0	14.0	1.4	0.1	2.3	8	n.r.
Thailand	171.7	93.5	2.8	72.7	2,377	1,407	28.3	22.8	35.0	75.9	13.1	0.6	261	2002
Turkmenistan	34.6	(18.0)	7.4	(35.2)	1,441	..	4.3	0.0	25.8	27.1	0.6	0.0	62	1999
Uzbekistan	121.0	(16.7)	4.9	(31.4)	4,992	..	8.7	16.4	29.9	46.2	13.5	0.1	181	1999
Viet Nam	47.5	147.6	0.6	108.9	854	(1,440)	32.5	26.4	22.8	68.1	12.9	0.1	130	2002
Europe	**6,071.0**	**(18.3)**	**8.3**	**(19.0)**	**292,323**	**14,591**	**13.1**	**13.5**	**33.8**	**987.1**	**518.9**	**77.9**	**7,638**	**..**
Albania	3.1	(55.1)	1.0	(52.6)	183	26	47.8	15.9	8.0	0.5	0.1	0.0	4	2005
Austria	64.4	8.1	7.9	3.1	2,465	45	28.3	25.4	21.1	9.7	2.8	1.1	79	2002 e
Belarus	59.6	(40.5)	5.9	(39.1)	3,358	45	10.5	16.3	53.1	21.6	8.3	0.1	79	n.r. e
Belgium	125.0	13.7	12.2	10.5	5,626	..	20.4	28.4	20.9	11.7	13.3	0.9	148	2002 e
Bosnia and Herzegovina	14.3	(41.6)	3.6	(36.8)	620	0	12.7	14.4	63.2	1.4	0.6	0.6	17	n.r.
Bulgaria	44.7	(43.0)	5.5	(38.6)	2,774	(17)	12.5	22.9	56.4	10.0	18.5	0.2	62	2002 e
Croatia	19.2	(39.9)	4.3	(34.5)	733	(4)	25.3	20.5	23.5	3.8	3.4	0.2	26	n.r. e
Czech Rep	124.1	(19.3)	12.1	(19.0)	6,744	(1)	11.1	20.5	52.1	10.8	8.2	0.4	143	2001 e
Denmark	51.3	2.0	9.6	(1.5)	2,490	8	23.9	10.9	46.4	6.0	9.3	0.5	66	2002 e
Estonia	14.9	(39.7)	10.9	(30.2)	833	16	10.8	7.3	72.3	2.4	0.4	0.0	22	2002 e
Finland	56.6	4.5	10.9	0.6	2,000	241	22.0	21.2	39.8	4.3	7.3	0.3	69	2002 e
France	363.5	(3.6)	6.1	(7.8)	18,619	52	39.3	21.6	12.0	59.3	72.3	7.6	512	2002 e
Germany	837.4	(15.2)	10.2	(18.1)	47,002	188	20.7	15.8	39.0	62.7	60.5	11.0	989	2002 e
Greece	92.2	21.6	8.5	13.4	2,084	(51)	22.7	12.5	51.5	10.9	11.2	2.4	120	2002 e
Hungary	56.9	(18.2)	5.7	(15.3)	3,033	6	16.2	14.1	40.3	11.3	12.9	0.4	76	2002 e
Iceland	2.2	8.5	7.9	(1.9)	81	..	29.2	35.6	0.0	0.3	0.1	0.2	3	2002 e
Ireland	42.8	29.8	11.2	19.5	1,186	(36)	25.8	12.9	38.6	12.9	9.8	0.5	67	2002 e
Italy	446.6	7.0	7.8	5.5	14,625	(5)	26.5	18.7	32.1	37.0	43.5	7.6	531	2002 e
Latvia	6.5	(55.4)	2.7	(49.0)	483	28	33.6	16.4	42.7	2.6	1.2	0.1	10	2002 e
Lithuania	11.6	(47.9)	3.3	(44.3)	747	23	27.2	18.0	34.4	5.9	3.5	0.1	15	2003 e
Macedonia, FYR	8.9	(11.1)	4.4	(16.2)	359	..	11.7	12.3	70.5	1.3	1.1	0.0	11	n.r.
Moldova, Rep	6.7	(65.0)	1.6	(64.3)	629	..	7.8	7.6	61.1	2.6	1.6	0.0	11	2003
Netherlands	174.8	10.4	11.0	3.8	6,370	2	19.1	20.6	31.6	21.6	17.2	4.5	216	2002 e
Norway	35.3	21.7	7.9	15.4	1,203	(18)	33.8	22.8	1.1	7.1	5.1	3.1	51	2002 e
Poland	303.8	(15.2)	7.9	(16.4)	15,873	52	8.7	17.1	53.8	47.2	23.9	0.5	382	2002 e
Portugal	64.8	48.8	6.5	47.1	1,254	(95)	30.5	21.3	35.5	14.3	8.1	0.3	79	2002 e
Romania	90.7	(48.5)	4.0	(46.8)	5,842	82	11.0	22.0	47.3	36.1	7.2	1.7	125	2001 e
Russian Federation	1,540.4	(32.1)	10.6	(30.9)	76,722	13,838	11.6	13.9	56.6	298.7	51.5	14.5	1,919	2004 e
Serbia and Montenegro	44.4	(27.7)	4.2	(30.5)	1,688	3	12.4	16.6	61.1	9.5	6.1	0.8	59	n.r.
Slovakia	36.9	(35.4)	6.9	(37.0)	2,303	22	11.4	29.7	40.5	4.2	3.2	0.3	46	2002 e
Slovenia	15.1	11.3	7.6	7.3	498	8	26.6	19.5	37.6	2.5	2.0	0.2	19	2002 e
Spain	304.9	35.1	7.5	30.3	7,662	(115)	32.3	19.3	32.5	39.6	30.1	7.4	381	2002 e
Sweden	48.8	(2.0)	5.5	(5.3)	3,017	257	48.2	23.8	13.7	7.1	7.1	0.7	64	2002 e
Switzerland	41.8	(6.0)	5.8	(10.4)	1,733	11	37.2	17.8	5.3	5.0	3.7	0.6	50	2003 e
Ukraine	348.4	(44.7)	7.0	(42.2)	21,048	..	4.9	27.6	27.9	153.5	19.9	0.5	517	2004 e
United Kingdom	558.2	(3.3)	9.5	(6.4)	29,791	(21)	24.4	12.2	33.4	51.1	43.8	8.6	660	2002 e
Middle East & N. Africa	**1,531.5**	**58.6**	**3.8**	**27.2**	**27,645**	**3,035**	**17.9**	**20.9**	**30.4**	**458.3**	**175.9**	**5.0**	**2,163**	**..**
Afghanistan	0.9	(65.7)	0.0	(77.7)	74	427	..	..	..	13.2	7.5	0.0	22	n.r.
Algeria	74.2	21.3	2.5	0.3	1,531	115	11.3	9.7	24.9	28.5	9.2	0.4	112	2005
Egypt	127.1	42.1	1.9	16.9	2,417	136	22.4	30.6	27.5	34.3	16.0	0.5	178	2005
Iran, Islamic Rep	297.9	59.1	4.5	35.8	5,528	565	22.9	20.4	22.0	96.9	43.8	0.2	439	n.r.
Iraq	78.5	31.1	3.4	(2.1)	1,704	9	36.6	23.2	23.8	14.4	6.5	0.0	100	n.r.
Israel	62.7	70.7	10.4	27.5	1,177	6	18.6	8.9	57.8	11.4	1.7	1.5	77	2004
Jordan	15.5	51.5	3.1	(2.1)	268	1	24.7	15.0	36.5	7.9	0.2	0.1	24	2003
Kuwait	58.5	173.6	26.0	160.9	1,167	0	9.6	25.7	37.8	9.9	0.2	0.3	69	2005
Lebanon	15.6	127.4	4.5	77.3	330	33	27.8	18.8	40.6	1.3	1.1	0.1	18	n.r.
Libyan Arab Jamahiriya	42.3	48.5	8.1	22.1	885	37	25.3	12.3	32.1	9.6	2.5	0.0	54	n.r.
Morocco	33.2	59.9	1.1	35.0	651	98	6.0	16.6	37.5	10.0	15.7	0.0	58	2002
Oman	25.0	131.0	9.6	63.3	255	0	11.8	30.9	33.0	3.7	1.0	0.1	30	2005
Saudi Arabia	266.1	75.8	12.0	31.4	4,081	0	11.7	10.3	25.4	54.4	8.7	0.7	330	2005
Syrian Arab Rep	51.3	51.8	3.1	16.6	878	6	11.6	21.7	31.9	9.7	9.4	0.2	71	n.r.
Tunisia	20.2	40.4	2.1	21.1	394	184	22.8	23.7	34.6	4.8	5.2	0.1	30	2003
Turkey	223.9	48.7	3.3	25.5	4,085	1,395	17.2	27.3	36.5	97.4	40.6	0.5	356	n.r. e
United Arab Emirates	72.3	66.6	25.6	20.2	1,028	..	8.0	43.0	45.1	35.2	0.1	0.2	108	2005
Yemen	10.4	34.8	0.6	(10.7)	246	18	51.3	5.6	17.4	8.7	5.6	0.0	25	2004

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	Carbon Dioxide (CO_2) Emissions {a}				Cumulative CO_2 Emissions (million metric tons)		CO_2 Emissions by Sector (as a percent of total CO_2 emissions)			Emissions (in million metric tons CO_2 equivalent) of			Total GHG Emissions {c} (million metric tons CO_2 equivalent)	Kyoto Protocol Status (year ratified, n.r. = not ratified) {d}
	Total		Per Capita											
	(million metric tons) 2000	(percent change since 1990)	(metric tons per person) 2000	(percent change since 1990)	From Fossil Fuels & Cement 1950-2000	From Land-Use Change 1950-2000	Trans-portation 2000	Industry & Construc-tion 2000	Elec-tricity 2000	Methane 2000	Nitrous Oxide 2000	Fluori-nated Gases {b} 2000	2000	
Sub-Saharan Africa	**492.1**	**19.7**	**0.8**	**(8.3)**	**13,867**	**39,934**	**..**	**..**	**..**	**498.7**	**350.6**	**8.5**	**1,323**	**..**
Angola	4.9	9.3	0.4	(17.5)	123	507	20.1	42.0	10.4	15.8	6.1	0.0	26	n.r.
Benin	1.7	325.4	0.3	216.7	20	1,030	60.3	9.9	3.3	3.3	2.7	0.0	7	2002
Botswana	4.0	85.9	2.3	45.9	52	560	..	..	..	7.0	4.8	0.0	15	2003
Burkina Faso	1.1	8.9	0.1	(18.0)	19	18	..	..	..	8.8	11.7	0.0	21	2005
Burundi	0.2	23.7	0.0	8.6	5	207	..	..	..	1.8	1.2	0.0	3	2001
Cameroon	3.4	12.2	0.2	(13.4)	75	2,193	62.3	7.4	1.0	11.8	9.8	2.3	27	2002
Central African Rep	0.3	44.4	0.1	14.9	7	255	..	..	..	6.6	5.1	0.0	11	n.r.
Chad	0.1	(9.1)	0.0	(32.0)	6	99	..	..	..	9.6	8.7	0.0	18	n.r.
Congo	0.8	(10.2)	0.2	(34.9)	28	281	59.5	10.8	0.0	3.2	1.0	..	5	n.r.
Congo, Dem Rep	2.5	(42.5)	0.1	(55.6)	153	9,025	26.4	37.4	1.1	32.9	17.2	0.0	53	2005
Côte d'Ivoire	7.1	131.3	0.5	82.6	133	2,592	18.2	8.8	30.9	6.5	2.9	0.0	16	n.r.
Equatorial Guinea	0.7	512.0	1.6	374.3	5	126	..	..	..	0.3	0.2	0.0	1	2000
Eritrea	0.6	..	0.2	..	6	..	33.3	6.7	23.3	0.0	..	0.0	1	n.r.
Ethiopia	3.6	42.0	0.1	5.7	73	240	55.5	27.1	0.6	47.5	12.2	0.0	59	2005
Gabon	1.5	21.5	1.2	(8.0)	69	104	27.3	25.2	29.4	3.8	1.8	0.0	7	n.r.
Gambia	0.3	46.6	0.2	4.4	6	(7)	..	..	..	0.7	0.5	0.0	1	2001
Ghana	5.9	85.9	0.3	44.5	125	794	52.0	14.2	10.4	7.1	7.4	0.2	20	2003
Guinea	1.3	32.1	0.2	0.0	40	297	..	..	..	5.7	2.4	0.0	9	2000
Guinea-Bissau	0.3	36.8	0.2	1.5	6	32	..	..	..	0.9	0.8	0.0	2	n.r.
Kenya	10.2	39.9	0.3	8.1	242	339	41.3	9.7	25.2	21.5	22.6	0.0	53	2005
Lesotho	0.2	35.5	0.1	19.2	3	0	..	..	..	1.2	1.5	0.0	3	2000
Liberia	0.4	(8.8)	0.1	(33.9)	35	1,120	..	..	..	1.2	0.8	0.0	2	2002
Madagascar	2.5	161.9	0.2	94.9	46	1,713	..	..	..	18.9	11.6	0.0	32	2003
Malawi	0.8	30.1	0.1	7.8	26	760	..	..	..	3.6	2.3	0.0	6	2001
Mali	0.6	34.9	0.0	2.1	15	228	..	..	..	12.0	13.8	0.0	25	2002
Mauritania	3.1	19.1	1.2	(8.6)	53	..	..	..	..	4.4	6.4	0.0	14	n.r.
Mozambique	1.2	16.9	0.1	(11.7)	92	264	68.3	5.7	0.8	11.1	3.2	0.0	15	2005
Namibia	1.9	..	1.0	..	18	65	63.1	7.5	1.6	4.5	4.2	0.0	10	2003
Niger	1.2	14.1	0.1	(19.0)	26	20	..	..	..	6.5	5.0	0.0	12	2004
Nigeria	48.1	20.4	0.4	(9.7)	1,054	5,540	42.9	12.7	12.3	72.5	41.6	0.3	163	n.r.
Rwanda	0.6	12.9	0.1	(1.3)	12	212	..	..	..	2.2	1.2	0.0	4	2004
Senegal	3.9	62.0	0.4	26.7	86	102	35.0	16.6	37.0	8.4	6.6	0.0	19	2001
Sierra Leone	0.6	71.8	0.1	58.5	22	379	..	..	..	2.6	0.9	0.0	4	n.r.
Somalia	..	..	..	..	..	148	..	..	..	..	..	..	..	n.r.
South Africa	344.6	16.8	7.8	(2.2)	10,165	49	10.4	17.4	53.8	37.4	25.8	5.4	413	2002
Sudan	5.9	5.4	0.2	(16.6)	166	867	48.1	15.1	23.3	46.6	47.1	0.1	96	2004
Tanzania, United Rep	2.7	16.7	0.1	(13.5)	89	414	53.9	22.2	20.4	31.7	27.1	0.0	59	2002
Togo	1.6	117.7	0.4	65.0	21	245	31.0	52.4	4.8	2.1	2.3	0.0	6	2004
Uganda	1.4	77.4	0.1	29.8	37	1,118	..	..	..	12.4	12.9	0.0	27	2002
Zambia	1.9	(35.6)	0.2	(49.4)	168	6,697	42.1	42.7	3.5	11.2	5.5	0.0	18	n.r.
Zimbabwe	14.1	(5.2)	1.1	(21.6)	468	1,349	15.9	22.1	38.2	11.0	8.6	0.1	33	n.r.
North America	**6283.5**	**18.2**	**19.9**	**6.1**	**229,327**	**(21,005)**	**30.1**	**12.1**	**40.7**	**736.8**	**487.4**	**137.4**	**7,599**	**..**
Canada	521.4	22.1	16.9	9.9	17,275	5,194	29.1	18.2	25.5	123.4	57.5	11.3	675	2002 e
United States	5762.1	17.9	20.2	5.8	212,052	(26,199)	30.2	11.5	42.1	613.4	430.0	126.1	6,924	n.r. e
C. America & Caribbean	**507.5**	**28.6**	**3.0**	**7.8**	**12,276**	**13,469**	**27.6**	**18.3**	**32.9**	**161.7**	**50.5**	**4.7**	**725**	**..**
Belize	0.8	165.9	3.4	106.1	10	949	..	..	..	0.2	0.2	0.0	1	2003
Costa Rica	5.2	67.5	1.3	31.1	104	439	64.5	17.8	1.3	3.6	3.6	0.1	12	2002
Cuba	31.4	(5.7)	2.8	(10.5)	1,151	(399)	6.4	45.2	39.9	9.1	9.3	0.2	50	2002
Dominican Rep	19.9	102.1	2.4	70.8	317	0	35.2	7.7	34.3	5.9	4.3	0.0	30	2002
El Salvador	6.6	148.1	1.1	104.4	111	184	46.7	20.9	20.6	3.2	2.2	0.1	12	1998
Guatemala	10.1	124.0	0.9	71.7	168	2,514	43.7	14.5	25.5	6.2	5.2	0.1	22	1999
Haiti	1.4	35.6	0.2	17.3	31	89	49.6	20.6	13.5	3.4	2.6	0.0	7	2005
Honduras	5.0	97.9	0.8	49.1	89	782	40.8	26.8	23.4	4.9	3.5	0.0	14	2000
Jamaica	10.3	40.8	4.0	29.3	268	117	19.1	5.5	54.1	1.3	1.3	0.1	13	1999
Mexico	385.1	24.7	3.9	4.9	9,238	4,300	28.1	15.9	33.2	111.7	10.0	4.1	511	2000
Nicaragua	3.6	54.2	0.7	16.3	82	2,385	41.9	11.3	40.7	5.3	4.0	0.0	13	1999
Panama	5.7	110.7	1.9	72.2	141	2,110	38.7	18.5	17.4	3.3	2.7	0.0	12	1999
Trinidad and Tobago	18.1	45.2	14.0	36.9	384	..	9.6	40.9	22.5	3.1	0.3	0.0	22	1999
South America	**796.9**	**42.0**	**2.3**	**21.0**	**20,753**	**91,234**	**35.4**	**25.7**	**13.4**	**639.0**	**369.3**	**11.4**	**1,812**	**..**
Argentina	139.0	31.1	3.7	15.0	4,322	2,448	32.2	15.3	19.4	86.7	63.4	0.7	287	2001
Bolivia	11.7	110.0	1.4	68.2	201	3,723	25.0	7.3	10.6	21.3	5.8	0.0	39	1999
Brazil	327.9	53.3	1.9	32.8	7,323	60,946	40.8	30.6	9.2	297.2	207.7	8.3	842	2002
Chile	54.8	72.9	3.6	48.7	1,204	687	30.5	21.7	26.1	14.5	7.5	0.1	77	2002
Colombia	64.0	23.3	1.5	2.4	1,800	4,715	31.4	33.0	11.9	55.5	41.2	0.2	161	2001
Ecuador	20.7	58.8	1.7	31.2	414	2,616	47.0	16.9	11.9	16.2	2.9	0.1	40	2000
Guyana	1.6	44.1	2.1	38.7	60	1,551	..	..	..	1.4	0.8	0.0	4	2003
Paraguay	3.7	70.8	0.7	31.7	68	916	84.9	7.9	0.6	12.3	10.2	0.0	26	1999
Peru	28.2	44.1	1.1	20.8	847	8,316	35.1	30.1	11.6	19.6	21.9	0.1	70	2002
Suriname	2.2	24.0	5.3	17.3	72	0	..	..	..	0.9	0.4	0.0	4	n.r.
Uruguay	6.4	50.1	1.9	39.6	252	(1,084)	41.1	15.0	7.3	18.3	0.7	0.1	26	2001
Venezuela	136.7	24.1	5.6	(0.4)	4,190	6,399	26.9	26.1	14.3	95.1	6.9	1.8	237	2005
Oceania	**369.1**	**26.4**	**12.3**	**8.8**	**10,224**	**6,362**	**..**	**..**	**..**	**155.0**	**43.4**	**..**	**578**	**..**
Australia	332.4	25.8	17.4	10.9	9,184	1,321	22.8	15.9	51.7	113.2	27.0	5.3	491	n.r. e
Fiji	0.7	(13.8)	0.9	(23.3)	26	12	..	..	..	1.0	1.1	..	3	1998
New Zealand	32.6	37.4	8.6	22.0	924	686	39.3	30.4	16.7	36.2	12.4	0.7	73	2002 e
Papua New Guinea	2.4	0.7	0.5	(22.4)	66	4,314	..	..	..	3.9	2.3	..	9	2002
Solomon Islands	0.2	6.2	0.4	(22.6)	4	19	..	..	..	0.1	0.1	0.0	0	2003
Developed	**14679.5**	**(2.0)**	**11.2**	**(6.5)**	**598,135**	**655**	**23.7**	**15.3**	**40.8**	**2,067.1**	**1,134.3**	**281.5**	**18,102**	**..**
Developing	**9268.5**	**47.5**	**1.9**	**25.6**	**186,721**	**310,586**	**16.1**	**24.5**	**36.1**	**3,741.0**	**2,265.7**	**92.8**	**15,285**	**..**

All emissions data are expressed in terms of carbon dioxide (CO_2) equivalent.

a. CO_2 emissions from land-use change are not included here. **b**. Fluorinated gas ('F' gas) emissions include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). **c**. Total emissions of all greenhouse gases (GHGs) include CO_2 emissions from fossil fuels and cement manufacture plus emissions of methane, nitrous oxide, and fluorinated gases. **d**. Status of countries as of July, 2005. **e**. Indicates Annex I (developed) countries, which are subject to different restrictions under the Kyoto Protocol.

Climate and Atmosphere: Technical Notes

DEFINITIONS AND METHODOLOGY

Total Carbon Dioxide (CO_2) Emissions measures the mass of carbon dioxide produced during combustion of solid, liquid, and gaseous fuels, as well as from gas flaring and the manufacture of cement. Data are expressed in million metric tons. CO_2 emissions from land-use change are not included here. These estimates do not include bunker fuels used in international transportation. Where values were originally in given in mass of carbon, WRI multiplied by 3.664 (the ratio of the molecular mass of CO_2 to that of carbon) to convert to mass of CO_2.

CO_2 Emissions Per Capita measures the mass of CO_2 produced per person for a country or region, in metric tons. WRI calculates per capita emissions with population estimates from the United Nations Population Division (2002 revision).

Data on carbon dioxide emissions are obtained from the World Resources Institute's Climate Analysis and Indicators Tool (CAIT). In order to provide the most complete and accurate data set, CAIT compiles data from the International Energy Agency (IEA), the Carbon Dioxide Information Analysis Center (CDIAC), and the Energy Information Agency (EIA). Fossil fuel emissions estimates for 131 countries are available from the IEA and reported in CAIT. WRI used CDIAC data on fossil fuel emissions for the 53 countries that lack IEA data. (Data for Lesotho were obtained from the EIA.) Data on emissions from cement manufacturing were obtained from CDIAC for all countries and added to the fossil-fuel emissions totals by WRI. A complete country-by-country listing of source and notes can be found at http://cait.wri.org/cait.php?page=notes&chapt=2.

Emissions are calculated by the IEA using the Intergovernmental Panel on Climate Change (IPCC) Reference Approach. CDIAC estimates are derived from energy statistics obtained from United Nations Statistical Office questionnaires and supplemented by official national statistical publications. The U.S. Energy Information Administration (EIA) estimates CO_2 emissions by country and year, based on energy balances.

Cumulative CO_2 Emissions from Fossil Fuels and Cement, 1950-2000 represents the total mass of CO_2 produced in all years from 1950 to 2000 as a result of the combustion of solid, liquid, and gaseous fuels, as well as from gas flaring and the manufacture of cement. CO_2 emissions from land use change are not included here. These estimates do not include bunker fuels used in international transportation. To estimate cumulative emissions in recently formed countries, WRI apportions emissions estimates based on current emissions and historical emissions from former countries and territories.

Cumulative CO_2 Emissions from Land-Use Change, 1950-2000 represents the total mass of carbon dioxide (CO_2) absorbed or emitted into the atmosphere between 1950 and 2000 as a result of man-made land-use changes (for example, deforestation, shifting cultivation, and vegetation re-growth on abandoned croplands and pastures). Positive values signify a positive net flux ("source") of CO_2, indicating that carbon dioxide has been released into the atmosphere. Negative values signify a negative net flux ("sink") of CO_2, indicating that carbon dioxide has been absorbed as a result of the re-growth of previously removed vegetation. Data include emissions from living and dead vegetation disturbed at the time of clearing or harvest, emissions from wood products (including fuel wood), and emissions from the oxidation of organic matter in the soil in years following initial cultivation. Ecosystems that are not directly affected by human activities such as agriculture and forestry are not included in these totals. The net flux of CO_2 for each country was calculated by R.A. Houghton at the Woods Hole Research Center based on regional fluxes. WRI calculated cumulative carbon emissions from land-use change using annual country-level data. For more information, refer to "Data Note: Emissions (and Sinks) of Carbon from Land-Use Change," online at http://cait.wri.org.

Carbon Dioxide Emissions by Sector shows the proportion of total CO_2 emissions from fossil fuel burning contributed by transportation, industry, and electricity production. The **Transportation** sector includes fossil fuel emissions from road, rail, air, and other forms of transportation, and agricultural vehicles while they are on highways. Data do not include international aviation or ship emissions. The **Industry and Construction** sectors include fossil fuel emissions in all industries and construction. The **Electricity** sector includes fossil fuel emissions from public electricity generation, combined heat and power generation, and heat plants. Emissions from electricity and heat production for use by the producer (autoproduction) for public or private activities are included here.

The emissions figures presented here are calculated by the IEA using the IPCC Sectoral Approach and default emission factors from the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and the IEA energy balances.

Methane Emissions measures the total release of methane (CH_4) into the earth's atmosphere that results from human activities such as agricultural and industrial methane production. Values are expressed in thousand metric tons of CO_2 equivalent using the global warming potential (GWP), which allows the different gases to be compared on the basis of their effective contributions. One kilogram of methane is 23 times as effective at trapping heat in the earth's atmosphere as a single kilogram of CO_2 (using a time horizon of 100 years).

Nitrous Oxide Total Emissions represents the total release of nitrous oxide (N_2O) into the earth's atmosphere that results from human activities such as agriculture, biomass burning, industrial activities, and livestock management. Values are expressed in thousand metric tons of CO_2 equivalent using the GWP, which allows the different gases to be compared on the basis of their effective contributions. The global warming potential of one kilogram of N_20 is nearly 300 times that of a single kilogram of CO_2 (using a time horizon of 100 years).

Fluorinated Gases Emissions represents the total release of hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) into the earth's atmosphere. These three groups of fluorinated gases ("f-gases") persist in the atmosphere for thousands of years. *Hydrofluorocarbons* are a by-product of HFC-23 and HCFC-22 (IPCC Source Categories 2E and 2F), which are used in the production of aerosols, refrigeration/AC compounds, solvents, foams, fire extinguishing compounds, semiconductors, and flat-panel displays. *Perfluorocarbons* are produced in the manufacture of semiconductors and as a byproduct of CF_4 and C_2F_6 in primary aluminum production (IPCC Source Categories 2C, 2E, and 2F). *Sulfur Hexafluoride* emissions are generated from magnesium processing, semiconductor production, and the use and manufacture of gas insulated switchgear in electricity distribution networks (IPCC Source Categories 2C and 2F). Values are expressed in thousand metric tons of CO_2 equivalent using the global warming potential (GWP), which allows the different gases to be compared on the basis of their effective contributions. The global warming potential of one kilogram of a fluorinated gas is several thousand times that of a single kilogram of CO_2 (using a time horizon of 100 years).

Most of the **Methane, Nitrous Oxide, and Fluorinated Gas** data shown here were compiled by WRI from *Non-CO_2 Gases Economic Analysis and Inventory.* This data set was prepared by the U.S. Environmental Protection Agency (EPA), covers 90 countries, and accounts for close to 90 percent of global emissions. The remaining data were either obtained from the EDGAR database of the Dutch National Institute of Public Health and the Environment (RIVM) or estimated by WRI based on regional totals and figures for earlier years. A complete listing of sources by country is available at http://cait.wri.org/cait.php?page=notes&chapt=2.

Total GHG Emissions include the total mass of carbon dioxide (CO_2) emitted from fossil fuel and cement manufacturing plus the CO_2 emissions equivalent of methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) in the year 2000. Data shown here exclude CO_2 from land-use change.

Kyoto Protocol Status indicates the year that a country ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Ratification (or its equivalents of acceptance, approval, or accession) binds the state to observe the treaty. The Kyoto Protocol was established in 1997 by the third session of the Conference of Parties (COP-3) to the UNFCCC. Upon ratification, Annex I (industrialized) countries commit themselves to reducing their collective emissions of six greenhouse gases by at least 5 percent from 1990 levels during the first commitment period, which is 2008-2012. Compared to emissions levels that would be expected by 2010 without emissions-control measures, the Protocol target represents a 30 percent cut. Under the Protocol, both developed and developing countries agree to limit emissions and promote adaptation to future climate change, submit information on their national climate-change program and inventories, promote technology transfer, cooperate on scientific and public research, and promote public awareness and education. The Protocol came into force on February 16, 2005, following ratification by Russia in November, 2004. More information is available in *A Guide to the Climate Change Convention Process,* online at http://unfccc.int/resource/process/guideprocess-p.pdf.

FREQUENCY OF UPDATE BY DATA PROVIDERS

Carbon dioxide emissions, cumulative emissions, and non-CO_2 greenhouse gas emissions are updated by WRI's CAIT tool when new data are available; most CO_2 emissions data are updated annually, while non-CO_2 GHG emissions are updated intermittently by RIVM and the EPA. Sectoral emissions data are updated by the IEA every year; as of spring, 2005, data are available from the original source through 2002. Sectoral emissions data from 2000 are included here to enable direct comparisons with the emissions data in this table.

DATA RELIABILITY AND CAUTIONARY NOTES

CO_2 Emissions: The IPCC Reference Approach (used here for most emissions estimates) can overestimate emissions because it uses energy supply data rather than combustion data. In a few cases, the estimates shown here differ significantly (by more than 5 percent) from those reported by individual countries or by the UNFCCC. This is because some countries use different energy figures than the IEA and WRI or treat bunker fuels differently. Other countries calculate emissions with specific calorific values instead of the averages used by the IEA.

Emissions data are synthesized by WRI from three different data sets, which presents both advantages and disadvantages. On the one hand, "filling" the gaps from different data sources improved the ability to make cross-country comparisons and related analyses. Yet comparability can be endangered when data points from different sources (using different methodologies) are placed side-by-side. For a complete discussion of CAIT's methodology, see http://cait.wri.org/downloads/cait_ghgs.pdf.

Cumulative CO_2 Emissions from Land-Use Change: CO_2 emissions estimates from land-use change are considerably less reliable than other CO_2 and GHG emissions estimates; as a result, data should be treated as order-of-magnitude estimates. The data provider states that yearly flux estimates are uncertain on the order of ±150 percent for large fluxes, and ±50 million tons of carbon per year for estimates near zero. The cumulative emissions presented here, however, are more accurate than the data for individual years. More information is available at: http://cait.wri.org/downloads/DN-LUCF.pdf.

CO_2 Emissions by Sector: Data shown in these columns are calculated using the IPCC Sectoral Approach, which surveys actual consumption of fossil fuels by each sector in order to calculate emissions. Other columns in the table have been calculated using the IPCC Reference Approach. While in theory the numbers should be identical, in practice there are minor variations between the data produced by the two methodologies.

Methane, Nitrous Oxide, and Fluorinated Gas Emissions: Generally, estimates of non-CO_2 GHG emissions are less certain than CO_2 emissions estimates. Estimates of nitrous oxide emissions are less certain than methane and fluorinated gas estimates. This data set provides a sound basis for comparability, however, since the methods used are comparable to IPCC methodologies, the global totals comply with budgets used in atmospheric studies, and the data were based on international information sources.

The data presented here may not match the official methane emissions estimates submitted by countries to the UNFCCC. In most cases, however, the differences are not substantial. In the year 2000, WRI estimated methane and nitrous oxide emissions for some countries (accounting for about 10 percent of all emissions); these estimates should be considered rough approximations.

SOURCES

Total and Cumulative Emissions: World Resources Institute. 2005. Climate Analysis Indicators Tool (CAIT), version 2.0. Washington D.C.: World Resources Institute. Online at http://cait.wri.org.

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