



# Table AC.1 Emissions from Fossil Fuel Burning and Cement Manufacturing

Source: Carbon Dioxide Information Analysis Center

	Carbon Dioxide (CO <sub>2</sub> ) Emissions (000 metric tons)								Per Capita Carbon Emissions (kg) 1996	CO <sub>2</sub> Emitted Per Million Int\$ (PPP) of Gross Domestic Product (a)		Signatory to the Kyoto Protocol 1999 (Yes/No)
	Solid Fuels 1996	Liquid Fuels 1996	Gaseous Fuels 1996	Gas Flaring 1996	Cement Manufacturing 1996	Total 1990	Total 1996	Total Contribution Since 1950		1990	1996	
<b>SUB-SAHARAN AFRICA</b>	<b>268,395</b>	<b>170,270</b>	<b>14,070</b>	<b>54,136</b>	<b>12,685</b>	<b>466,991</b>	<b>519,548</b>	<b>12,928,091</b>	<b>894</b>	<b>X</b>	<b>X</b>	<b>X</b>
Angola	0	2,151	344	2,465	149	4,650	5,108	145,552	450	291	288	N
Benin	0	465	0	0	189	564	656	14,762	120	122	94	N
Botswana	6,383	12,579	4	9	691	2,415	19,665	51,505	13,035	337	1,778	N
Burkina Faso	0	967	0	0	0	1,008	967	14,682	90	146	96	N
Burundi	18	202	0	0	0	194	220	3,975	35	46	54	N
Cameroon	4	3,213	0	0	299	1,488	3,517	86,507	260	65	139	N
Central African Rep	0	234	0	0	0	198	234	5,866	70	X	X	N
Chad	0	99	0	0	0	143	99	5,027	14	35	15	N
Congo	0	4,741	7	167	50	2,037	4,961	40,161	1,884	X	X	N
Congo, Dem Rep	854	1,436	0	0	5	4,096	2,294	142,475	49	X	X	N
Côte d'Ivoire	0	12,817	0	0	249	9,907	13,066	185,109	946	X	X	N
Equatorial Guinea	0	143	0	0	0	117	143	2,862	349	X	X	N
Eritrea	X	X	X	X	X	X	X	X	X	X	X	N
Ethiopia	0	3,048	0	0	320	2,964	3,367	66,509	59	144	117	N
Gabon	0	2,041	1,587	0	65	6,112	3,690	135,432	3,333	1,019	437	N
Gambia	0	216	0	0	0	191	216	4,481	188	X	X	N
Ghana	7	3,342	0	0	698	3,539	4,045	109,271	223	187	142	N
Guinea	0	1,092	0	0	0	1,011	1,092	32,445	150	126	88	N
Guinea-Bissau	0	231	0	0	0	209	231	4,477	208	X	X	N
Kenya	267	5,760	0	0	747	5,822	6,775	180,020	243	228	203	N
Lesotho	X	X	X	X	X	X	X	X	X	X	X	N
Liberia	0	326	0	0	0	465	326	33,189	148	X	X	N
Madagascar	44	1,121	0	0	30	945	1,198	37,860	84	87	94	N
Malawi	44	616	0	0	70	601	733	18,184	75	127	105	N
Mali	0	462	0	0	10	421	473	12,025	46	81	66	Y
Mauritania	15	2,876	0	0	60	2,634	2,950	40,648	1,232	943	720	N
Mozambique	158	821	0	0	15	997	997	89,149	56	132	91	N
Namibia	X	X	X	X	X	X	X	X	X	X	X	N
Niger	458	649	0	0	15	1,048	1,121	20,863	119	162	139	Y
Nigeria	150	21,596	8,596	51,494	1,495	88,665	83,330	1,944,327	822	1,196	802	N
Rwanda	0	484	0	2	5	528	491	9,167	90	96	105	N
Senegal	0	2,770	0	0	294	2,895	3,063	76,142	358	263	211	N
Sierra Leone	0	447	0	0	0	333	447	19,844	104	128	182	N
Somalia	0	0	0	0	15	18	15	13,747	2	X	X	N
South Africa	227,707	56,821	3,532	0	4,684	291,108	292,746	8,541,575	7,678	1,236	986	N
Sudan	0	3,283	0	0	189	3,459	3,473	137,001	128	148	83	N
Tanzania, United Rep	15	2,030	0	0	399	2,272	2,444	61,694	80	166	146	N
Togo	0	575	0	0	174	689	751	17,023	180	140	121	N
Uganda	0	986	0	0	50	846	1,033	32,837	53	67	46	N
Zambia	773	1,499	0	0	174	2,444	2,444	111,151	291	344	277	Y
Zimbabwe	13,623	4,217	0	0	573	16,646	18,412	369,232	1,667	818	705	N
<b>NORTH AMERICA</b>	<b>2,012,492</b>	<b>2,279,862</b>	<b>1,354,255</b>	<b>18,726</b>	<b>45,005</b>	<b>5,233,610</b>	<b>5,710,344</b>	<b>200,969,374</b>	<b>19,074</b>	<b>X</b>	<b>X</b>	<b>X</b>
Canada	94,927	148,293	156,434	4,190	5,506	409,628	409,353	14,855,347	13,669	790	622	Y
United States	1,917,565	2,131,569	1,197,820	14,535	39,499	4,823,982	5,300,991	186,114,027	19,674	858	706	Y
<b>C. AMERICA &amp; CARIBBEAN</b>	<b>20,196</b>	<b>367,202</b>	<b>81,885</b>	<b>6,560</b>	<b>16,832</b>	<b>411,973</b>	<b>499,033</b>	<b>11,518,037</b>	<b>3,078</b>	<b>X</b>	<b>X</b>	<b>X</b>
Belize	0	355	0	0	0	311	355	7,478	1,624	469	368	N
Costa Rica	0	4,192	0	0	493	2,917	4,683	85,756	1,282	188	209	Y
Cuba	509	29,854	84	0	724	31,818	31,170	1,018,401	2,829	X	X	Y
Dominican Rep	341	11,805	0	0	747	9,435	12,890	237,779	1,619	X	X	Y
El Salvador	0	3,572	0	0	472	2,616	4,045	82,535	699	254	245	Y d
Guatemala	0	6,210	22	0	543	5,086	6,775	138,961	661	181	163	Y d
Haiti	0	1,048	0	0	25	993	1,070	25,238	139	107	114	N
Honduras	0	3,550	0	0	479	2,590	4,027	72,591	692	268	315	Y
Jamaica	169	9,603	0	0	277	7,958	10,050	234,650	4,029	1,069	1,113	X c,d
Mexico	17,910	248,104	67,165	3,549	11,376	294,974	348,106	7,760,957	3,754	525	470	Y
Nicaragua	0	2,686	0	0	174	2,601	2,862	70,015	629	455	322	Y
Panama	150	6,240	174	0	174	3,129	6,679	129,933	2,495	259	357	Y d
Trinidad and Tobago	0	4,536	14,385	3,010	307	16,924	22,237	489,957	17,508	2,521	2,570	Y d
<b>SOUTH AMERICA</b>	<b>73,514</b>	<b>460,568</b>	<b>143,413</b>	<b>24,600</b>	<b>33,789</b>	<b>572,181</b>	<b>735,885</b>	<b>17,875,788</b>	<b>2,260</b>	<b>X</b>	<b>X</b>	<b>X</b>
Argentina	3,019	63,853	54,502	5,929	2,550	109,729	129,852	3,853,154	3,687	519	381	Y
Bolivia	0	4,639	3,239	1,759	465	5,500	10,102	159,637	1,330	377	468	Y
Brazil	44,642	197,585	10,622	3,284	17,240	202,612	273,371	5,706,610	1,692	273	266	Y
Chile	11,439	31,573	3,635	321	1,811	36,263	48,779	1,076,150	3,383	383	278	Y
Colombia	11,871	38,901	9,658	719	4,159	55,850	65,307	1,589,993	1,662	313	246	N
Ecuador	0	20,918	1,271	960	1,334	16,569	24,487	421,888	2,093	408	428	Y
Guyana	0	953	0	0	0	1,132	953	51,915	1,138	848	379	N
Paraguay	0	3,386	0	0	309	2,261	3,697	53,960	746	163	204	Y d
Peru	1,447	22,416	352	43	1,917	22,175	26,176	771,034	1,093	357	244	Y
Suriname	0	2,074	0	0	25	1,810	2,099	63,647	5,115	X	X	N
Uruguay	4	5,298	0	0	341	3,909	5,643	217,601	1,741	200	196	Y
Venezuela	1,092	68,055	60,134	11,584	3,638	113,569	144,501	3,897,477	6,477	798	765	N
<b>OCEANIA</b>	<b>198,424</b>	<b>92,047</b>	<b>48,061</b>	<b>0</b>	<b>3,833</b>	<b>295,524</b>	<b>342,360</b>	<b>8,582,495</b>	<b>11,842</b>	<b>X</b>	<b>X</b>	<b>X</b>
Australia	192,774	72,723	37,897	0	3,239	266,010	306,633	7,622,743	16,902	1,011	820	N
Fiji	59	660	0	0	46	813	762	23,058	981	326	230	Y d
New Zealand	5,141	14,110	10,003	0	498	23,596	29,752	791,083	7,997	508	463	Y
Papua New Guinea	4	2,246	161	0	0	2,429	2,407	56,202	547	X	X	Y
Solomon Islands	0	161	0	0	0	161	161	3,488	412	263	171	Y

Notes: Negative values are shown in parentheses. "0" is either zero or less than one-half the unit of measure. a. Gross domestic product figures are calculated using purchasing power parity (PPP) and are in current international dollars. b. Data are estimated for the countries of the former Soviet Union and former Czechoslovakia before 1992. (See technical notes for further explanation.) c. Country went straight to ratification. d. Country has ratified the Kyoto Protocol. e. Includes Singapore until 1957. f. Data before 1970 refer to the Democratic Republic of Viet Nam and South Viet Nam. g. Data before 1991 refer to the Democratic Republic of Germany and the Federal Republic of Germany. h. Data include Bosnia and Herzegovina, Croatia, Macedonia (FYR), Slovenia, Yugoslavia, and the former Socialist Federal Republic of Yugoslavia. i. Data before 1991 refer to the People's Democratic Republic of Yemen and the Republic of Yemen.

**Table AC.1 Emissions from Fossil Fuel Burning and Cement Manufacturing**

Source: All fossil fuel carbon dioxide emissions data: Carbon Dioxide Information Analysis Center (CDIAC), Global, Regional, and National Annual CO<sub>2</sub> Emissions from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring: 1751–1996, ORNL/CDIAC-25, NDP-030 (Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee, March 1999). Data are available online at: <http://cdiac.esd.ornl.gov/ftp/ndp030/>. Gross domestic product at purchasing power parity in current international dollars: World Bank, World Development Indicators 1999, on CD-ROM (Development Data Group, World Bank, Washington, D.C., 1999). Population figures for per capita calculations: United Nations (U.N.) Population Division, Annual Populations 1950–2050 (The 1998 Revision), on diskette (U.N., New York, 1999). Kyoto Protocol data: U.N. Framework Convention on Climate Change (an Internet-accessible numerical database) available online at: <http://www.unfccc.de/>.

Carbon dioxide (CO<sub>2</sub>) emissions are often calculated and reported in terms of their content of elemental carbon. For this table, their values were converted to the actual mass of CO<sub>2</sub> by multiplying the carbon mass by 3.664 (the ratio of the mass of CO<sub>2</sub> to that of carbon).

These data from CDIAC represent a complete harmonized global dataset of CO<sub>2</sub> emissions. However, individual country estimates, based on more detailed information and a country-specific methodology, could differ. Guidelines were developed to assist in the preparation of national greenhouse gases inventories. The Intergovernmental Panel on Climate Change (IPCC) accepted these guidelines at its Twelfth Session in Mexico City on September 11–13, 1996. The guidelines were published in Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, Cambridge, England, 1997). Such data are currently available for an increasing number of countries, but long time series are rare. Methods used by CDIAC have the advantage of calculating CO<sub>2</sub> emissions from a single common dataset available for all countries.

Solid fuels, liquid fuels, and gaseous fuels are primarily, but not exclusively, coals, petroleum products, and natural gas, respectively. Gas flaring is the practice of burning off gas released in the process of petroleum extraction, a practice that is declining. During cement manufacturing, cement is calcined to produce calcium oxide. In the process, 0.498 metric ton of CO<sub>2</sub> is released for each ton of cement produced. Total emissions for 1990 and 1996 consist of the sum of the CO<sub>2</sub> produced during the consumption of solid, liquid, and gaseous fuels, and from gas flaring and the manufacture of cement. However, these estimates do not include bunker fuels used in international transportation due to the difficulty of apportioning these fuels among the countries benefiting from that transport. For more information, please see the World Resources 2000–01 Database CD-ROM or the original source for data on emissions from bunker fuels.

CDIAC annually calculates emissions of CO<sub>2</sub> from the burning of fossil fuels and the manufacture of cement for most of the countries of the world. CDIAC calculates emissions from data on the net apparent consumption of fossil fuels (based on the World Energy Data Set maintained by the U.N. Statistical Division) and from data on world cement manufacturing (based on the Cement Manufacturing Data Set maintained by the U.S. Geological Survey). Emissions are calculated using conversion factors based on global average fuel chemistry and oxidation rates.

Total contribution since 1950 represents total carbon dioxide emitted from 1950 to 1996, excluding bunker fuels. For the independent republics of the former Soviet Union, CO<sub>2</sub> emissions from 1950 to 1991 are estimates based on each country's post-1991 share of all emissions from the entire former Soviet Union. Total 1992 CO<sub>2</sub> emissions for the former Soviet Union were 3,289,909 tons; the share of that total was then calculated for each of the former Soviet republics. For example, Kazakhstan's

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emissions in 1992 were calculated to be 8.90 percent of the total carbon emitted from the former Soviet Union. The same approach was used for the other former Soviet republics. Therefore, the total contributions for the former Soviet republics from 1950 to 1991 should be taken only as rough approximations. An equivalent method was used to calculate historical estimates for the former Czechoslovakia.

Per capita carbon emissions are calculated using 1996 CO<sub>2</sub> emissions and the 1996 population estimates from the U.N. Population Division (medium-case scenario).

The carbon dioxide intensity of a country's economic output is expressed as CO<sub>2</sub> emitted per million international dollars (PPP) of gross domestic product in metric tons. Gross domestic product (GDP) measures the final output of goods and services produced by the domestic economy. The international dollar values, which are different from U.S. dollar values, are obtained using special conversion factors designed to equalize the purchasing powers of different currencies. This conversion factor, the purchasing power parity (PPP), is defined as the number of units of a country's currency that are required to buy the same amounts of goods and services in the domestic market as \$1 would buy in the United States. The computation involves deriving implicit quantities from national account expenditure data and specially collected price data, and then revaluing the implicit quantities in each country at a single set of average prices. Because the same international price averages are used for every country, cross-country comparisons reflect differences in quantities of goods and services free of price-level differences. This procedure is designed to bring cross-country comparisons in line with cross-time real-value comparisons that are based on constant price series. PPP estimates tend to lower per capita GDPs in industrialized countries and raise per capita GDPs in developing countries.

Information concerning whether a country is a signatory and whether they have ratified the Kyoto Protocol is current through October 1999. The Kyoto Protocol attempts to place legally binding limits on greenhouse gas emissions (carbon dioxide [CO<sub>2</sub>], methane [CH<sub>4</sub>], nitrous oxide [N<sub>2</sub>O], hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], and sulfur hexafluoride [SF<sub>6</sub>]) from developed countries. By signing the treaty, a state recognizes the authentic text, intends to complete the procedures for becoming legally bound by it, and is committed not to act against the treaty's objectives before ratification. Ratification (or its alternatives of acceptance, approval, or accession) binds the state to observe the treaty. Depending on a country's system of governance, signing the treaty may be simply an executive decision while ratification may require legislative approval. Quantitative obligations by developed countries will be based on the base year of 1990. For further information about the Kyoto Protocol, please refer to the information available online at: <http://www.unfccc.de/resource/convkp.html>.