Annex A

Methodology for Estimating Emissions of CO_2 from Fossil Fuel Combustion

Carbon dioxide (CO_2) emissions from fossil fuel combustion were estimated using a "bottom-up" methodology characterized by six steps. These steps are described below. Methodological and data changes from previous inventories are outlined at the end of this discussion.

Step 1: Determine Energy Consumption by Fuel Type and End-Use Sector

The bottom-up methodology used by the United States for estimating CO_2 emissions from fossil fuel combustion is conceptually similar to the approach recommended by the Intergovernmental Panel on Climate Change (IPCC) for countries that intend to develop detailed, sectoral-based emission estimates (IPCC/UNEP/OECD/IEA 1997). Basic consumption data are presented in Columns 2-8 of Table A-1 through Table A-7, with totals by fuel type in Column 8 and totals by end-use sector in the last rows. Fuel consumption data for the bottom-up approach were obtained directly from the Energy Information Administration (EIA) of the U.S. Department of Energy. The EIA data were collected through surveys at the point of delivery or use; therefore, they reflect the reported consumption of fuel by end-use sector and fuel type. Individual data elements were supplied by a variety of sources within EIA. Most information was taken from published reports, although some data were drawn from unpublished energy studies and databases maintained by EIA.

Energy consumption data were aggregated by end-use sector (i.e., residential, commercial, industrial, transportation, electric utilities, and U.S. territories), primary fuel type (e.g., coal, natural gas, and petroleum), and secondary fuel type (e.g., motor gasoline, distillate fuel, etc.). The 1996 total energy consumption across all sectors, including territories, and energy types was 79,419 trillion Btu, as indicated in the last entry of Column 8 in Table A-1. This total includes fuel used for non-fuel purposes and fuel consumed as international bunkers, both of which are deducted in later steps.

There are two modifications made in this report that may cause consumption information herein to differ from figures given in the cited literature. These are the consideration of synthetic natural gas production and ethanol added to motor gasoline.

First, a portion of industrial coal accounted for in EIA combustion figures is actually used to make "synthetic natural gas" via coal gasification. The energy in this gas enters the natural gas stream, and is accounted for in natural gas consumption statistics. Because this energy is already accounted for as natural gas, it is deducted from industrial coal consumption to avoid double counting. This makes the figure for other industrial coal consumption in this report slightly lower than most EIA sources.

Second, ethanol has been added to the motor gasoline stream for several years, but prior to 1993 this addition was not captured in EIA motor gasoline statistics. Starting in 1993, ethanol was included in gasoline statistics. However, because ethanol is a biofuel, which is assumed to result in no net CO_2 emissions, the amount of ethanol added is subtracted from total gasoline consumption. Thus, motor gasoline consumption statistics given in this report may be slightly lower than in EIA sources.

There are also three basic differences between the consumption figures presented in Table A-1 and those recommended in the IPCC emission inventory methodology.

First, consumption data in the U.S. inventory are presented using higher heating values (HHV)[1] rather than the lower heating values (LHV)[2] reflected in the IPCC emission inventory methodology. This convention is followed because data obtained from EIA are based on HHV.

[1] Also referred to as Gross Calorific Values (GCV).
[2] Also referred to as Net Calorific Values (NCV).

Second, while EIA's energy use data for the United States includes only the 50 U.S. states and the District of Columbia, the data reported to the Framework Convention on Climate Change are to include energy consumption within territories. Therefore, consumption estimates for U.S. territories were added to domestic consumption of fossil fuels. Energy consumption data from U.S. territories are presented in Column 7 of Table A-1. It is reported separately from domestic sectoral consumption, because it is collected separately by EIA with no sectoral disaggregation.

Third, the domestic sectoral consumption figures in Table A-1 include bunker fuels and non-fuel uses of energy. The IPCC recommends that countries estimate emissions from bunker fuels separately and exclude these emissions from national totals, so bunker fuel emissions have been estimated in Table A-8 and deducted from national estimates (see Step 4). Similarly, fossil fuels used to produce non-energy products that store carbon rather than release it to the atmosphere are provided in Table A-9 and deducted from national emission estimates (see Step 3).

Step 2: Determine the Carbon Content of All Fuels

The carbon content of combusted fossil fuels was estimated by multiplying energy consumption (Columns 2 through 8 of Table A-1) by fuel specific carbon content coefficients (Table A-10 and Table A-11) that reflected the amount of carbon per unit of energy inherent in each fuel. The resulting carbon contents are sometimes referred to as potential emissions, or the maximum amount of carbon that could potentially be released to the atmosphere if all carbon in the fuels were converted to CO_2. The carbon content coefficients used in the U.S. inventory were derived by EIA from detailed fuel information and are similar to the carbon content coefficients contained in the IPCC's default methodology (IPCC/UNEP/OECD/IEA 1997), with modifications reflecting fuel qualities specific to the United States.

Step 3: Adjust for the amount of Carbon Stored in Products

Depending on the end-use, non-fuel uses of fossil fuels can result in long term storage of some or all of the carbon contained in the fuel. For example, asphalt made from petroleum can sequester up to 100 percent of the carbon contained in the petroleum feedstock for extended periods of time. Other non-fuel products, such as lubricants or plastics also store carbon, but can lose or emit some of this carbon when they are used and/or burned as waste.

The amount of carbon sequestered or stored by non-fuel uses of fossil fuel products was based upon data that addressed the ultimate fate of various energy products, with all non-fuel use attributed to the industrial, transportation, and territories end-use sectors. This non-fuel consumption is presented in Table A-9. Non-fuel consumption was then multiplied by fuel specific carbon content coefficients (Table A-10 and Table A-11) to obtain the carbon content of the fuel, or the maximum amount of carbon that could be sequestered if all the carbon in the fuel were stored in non-fuel products (Columns 5 and 6 of Table A-9). This carbon content was then multiplied by the fraction of carbon assumed to actually have been sequestered in products (Column 7 of Table A-9), resulting in the final estimates of carbon stored by sector and fuel type, which are presented in Columns 8 through 10 of Table A-3. The portions of carbon sequestered were based on EIA data.

Step 4: Subtract Carbon from Bunker Fuels.

Emissions from international transport activities, or bunker fuel consumption, were not included in national totals. There is currently disagreement internationally as to which countries are responsible for these emissions, and until this issue is resolved, countries are asked to report these emissions separately. However, EIA data includes bunker fuels—primarily residual oil—as part of fuel consumption by the transportation end-use sector. To compensate for this inclusion, bunker fuel emissions were calculated separately (Table A-8) and the carbon content of these fuels was subtracted from the transportation end-use sector. The calculations of bunker fuel emissions followed the same procedures used for other fuel emissions (i.e., estimation of consumption, determination of carbon content, and adjustment for the fraction of carbon not oxidized).

Step 5: Account for Carbon that Does Not Oxidize During Combustion

Because combustion processes are not 100 percent efficient, some of the carbon contained in fuels is not emitted to the atmosphere. Rather, it remains behind as soot, particulate matter, or other by-products of inefficient

combustion. The estimated fraction of carbon not oxidized in U.S. energy conversion processes due to inefficiencies during combustion ranges from 0.5 percent for natural gas to 1 percent for petroleum and coal. Except for coal these assumptions are consistent with the default values recommended by the IPCC (IPCC/UNEP/OECD/IEA 1997). In the U.S. unoxidized carbon from coal combustion was estimated to be no more than one percent (Bechtel 1993). Table A-10 presents fractions oxidized by fuel type, which are multiplied by the net carbon content of the combusted energy to give final emissions estimates.

Step 6: Summarize Emission Estimates

Actual CO_2 emissions in the United States were summarized by major fuel (i.e., coal, petroleum, natural gas, geothermal) and consuming sector (i.e., residential, commercial, industrial, transportation, electric utilities, and territories). Adjustments for bunker fuels and carbon sequestered in products were made. Emission estimates are expressed in terms of million metric tons of carbon equivalents (MMTCE).

To determine total emissions by final end-use sector, emissions from electric utilities were distributed over the five end-use sectors according to their share of electricity consumed (see Table A-12).

Differences with Previous Years' Inventories

Two minor changes were made to the estimates of CO_2 emissions from energy consumption in this year's report. The first change concerns how emissions from unmetered natural gas consumption were handled. The second change pertains to accounting for non-fuel uses of fossil fuels in U.S. territories.

Previous inventories included calculations of emissions from unmetered natural gas consumption. Previously, the EIA provided this consumption data, which was calculated as the difference between reported gas production and reported consumption. For many years, the reported amount of gas produced was greater than the amount of gas consumed. EIA assumed that this difference was due to leakage and measurement errors and unmetered consumption. However, during the past two years, the reported amount of gas consumed was higher than the quantity of gas reported to have been produced. This occurrence casts doubt on what composes this difference. Therefore, this year calculations of emissions from unmetered natural gas consumption were not included in the emission estimates.

This year's estimates account for the non-fuel use in U.S. territories. Previous inventories overlooked this small source (0.17 MMTCE in 1996) of carbon sequestration.

Table A-1: 1996 Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
	Consumption (TBtu)							Emissions (MMTCE) including Adjustments* and Fraction Oxidized						
Fuel Type	**Res.**	**Comm.**	**Ind.**	**Trans.**	**Utility**	**Terr.**	**Total**	**Res.**	**Comm.**	**Ind.**	**Trans.**	**Utility**	**Terr.**	**Total**
Residential Coal	53.7						53.7	1.4						1.4
Commercial Coal		81.0					81.0		2.1					2.1
Industrial Coking Coal			849.7				849.7			20.9				20.9
Industrial Other Coal			1,489.3				1,489.3			38.5				38.5
Coke Imports			(0.3)				(0.3)			(0.0)				(0.0)
Transportation Coal				0.0			0.0				0.0			0.0
Utility Coal					18,086.4		18,086.4					460.9		460.9
US Territory Coal (bit)						10.3	10.3						0.255	0.3
Total Coal	53.7	81.0	2,338.7	0.0	18,086.4	10.3	20,570.0	1.4	2.1	59.4	0.0	460.9	0.3	524.0
Natural Gas	5,375.8	3,289.9	10,311.3	730.6	2,800.8	NA	22,508.4	77.4	47.4	143.0	10.5	40.3	NA	318.6
Asphalt & Road Oil	0.0	0.0	1,175.9	0.0	0.0		1,175.9	0.0	0.0	(0.0)	0.0	0.0	0.000	(0.0)
Aviation Gasoline	0.0	0.0	0.0	37.4	0.0		37.4	0.0	0.0	0.0	0.7	0.0	0.000	0.7
Distillate Fuel Oil	937.5	493.7	1,166.3	4,468.0	109.0	130.7	7,305.2	18.5	9.8	23.0	86.1	2.2	2.581	142.1
Jet Fuel	0.0	0.0	0.0	3,274.2	0.0	79.1	3,353.4	0.0	0.0	0.0	56.7	0.0	1.514	58.2
Kerosene	82.1	24.6	21.4	0.0	0.0		128.1	1.6	0.5	0.4	0.0	0.0	0.000	2.5
LPG	422.0	74.5	2,130.4	34.3	0.0	5.6	2,666.7	7.1	1.3	13.0	0.6	0.0	0.094	22.0
Lubricants	0.0	0.0	172.5	163.0	0.0	1.3	336.8	0.0	0.0	1.7	1.6	0.0	0.013	3.4
Motor Gasoline	0.0	26.2	199.8	14,879.2	0.0	93.7	15,198.9	0.0	0.5	3.8	285.5	0.0	1.783	291.6
Residual Fuel	0.0	156.8	376.0	813.0	605.9	151.7	2,103.4	0.0	3.3	8.0	3.1	12.9	3.227	30.6
Other Petroleum						76.7	76.7						1.367	1.4
AvGas Blend Components			7.0				7.0			0.1				0.1
Crude Oil			13.7				13.7			0.3				0.3
MoGas Blend Components			0.0				0.0			0.0				0.0
Misc. Products			89.0				89.0			1.8				1.8
Naphtha (<401 deg. F)			479.3				479.3			8.6				8.6
Other Oil (>401 deg. F)			729.6				729.6			14.4				14.4
Pentanes Plus			355.0				355.0			1.8				1.8
Petrochemical Feedstocks			0.0				0.0			(13.7)				(13.7)
Petroleum Coke			816.0		20.5		836.5			19.6		0.6		20.2
Still Gas			1,437.1				1,437.1			24.9				24.9
Special Naphtha			74.5				74.5			1.5				1.5
Unfinished Oils			(112.8)				(112.8)			(2.3)				(2.3)
Waxes			48.7				48.7			1.0				1.0
Other Wax & Misc.			0.0				0.0			(3.4)				(3.4)
Total Petroleum	1,441.6	775.8	9,179.5	23,669.1	735.5	538.8	36,340.2	27.2	15.3	104.6	434.3	15.6	10.580	607.7
Geothermal					0.018		0.018					0.0369		0.0369
TOTAL (All Fuels)	6,871.0	4,146.7	21,829.5	24,399.7	21,622.7	549.1	79,418.7	106.0	64.8	307.0	444.8	516.9	10.835	1,450.3

*Adjustments include: international bunker fuel consumption (see Table A-8) and carbon stored in products (see Table A-9)
NA (Not Available)

Table A-2: 1995 Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
	Consumption (TBtu)							Emissions (MMTCE) including Adjustments* and Fraction Oxidized						
Fuel Type	**Res.**	**Comm.**	**Ind.**	**Trans.**	**Utility**	**Terr.**	**Total**	**Res.**	**Comm.**	**Ind.**	**Trans.**	**Utility**	**Terr.**	**Total**
Residential Coal	53.7						53.7	1.4						1.4
Commercial Coal		81.0					81.0		2.1					2.1
Industrial Coking Coal			884.7				884.7			21.8				21.8
Industrial Other Coal			1,530.7				1,530.7			39.6				39.6
Coke Imports			26.4				26.4			0.7				0.7
Transportation Coal				0.0			0.0				0.0			0.0
Utility Coal					16,978.9		16,978.9					432.7		432.7
US Territory Coal (bit)						10.2	10.2						0.255	0.3
Total Coal	53.7	81.0	2,441.9	0.0	16,978.9	10.2	19,565.7	1.4	2.1	62.1	0.0	432.7	0.3	498.5
Natural Gas	4,981.3	3,185.2	10,064.3	722.0	3,276.4	NA	22,229.3	71.7	45.9	139.7	10.4	47.2	NA	314.8
Asphalt & Road Oil	0.0	0.0	1,178.2	0.0	0.0		1,178.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0
Aviation Gasoline	0.0	0.0	0.0	39.6	0.0		39.6	0.0	0.0	0.0	0.7	0.0	0.000	0.7
Distillate Fuel Oil	893.1	470.3	1,118.7	4,244.4	90.7	135.5	6,952.5	17.6	9.3	22.1	81.8	1.8	2.675	135.3
Jet Fuel	0.0	0.0	0.0	3,132.2	0.0	81.6	3,213.8	0.0	0.0	0.0	54.2	0.0	1.562	55.8
Kerosene	71.7	21.5	18.7	0.0	0.0		111.8	1.4	0.4	0.4	0.0	0.0	0.000	2.2
LPG	398.3	70.3	2,010.8	32.4	0.0	5.6	2,517.3	6.7	1.2	12.5	0.5	0.0	0.095	21.0
Lubricants	0.0	0.0	177.8	167.9	0.0	1.4	347.1	0.0	0.0	1.8	1.7	0.0	0.014	3.5
Motor Gasoline	0.0	25.8	196.7	14,586.4	0.0	97.9	14,906.8	0.0	0.5	3.8	279.9	0.0	1.863	286.0
Residual Fuel	0.0	168.9	371.5	870.0	544.4	156.2	2,110.9	0.0	3.6	7.9	2.9	11.6	3.323	29.3
Other Petroleum						79.3	79.3						1.414	1.4
AvGas Blend Components			5.3				5.3			0.1				0.1
Crude Oil			14.5				14.5			0.3				0.3
MoGas Blend Components			0.0				0.0			0.0				0.0
Misc. Products			97.1				97.1			1.9				1.9
Naphtha (<401 deg. F)			373.0				373.0			6.7				6.7
Other Oil (>401 deg. F)			801.0				801.0			15.8				15.8
Pentanes Plus			337.9				337.9			1.7				1.7
Petrochemical Feedstocks			0.0				0.0			(12.9)				(12.9)
Petroleum Coke			779.0		22.9		802.0			18.9		0.6		19.5
Still Gas			1,417.5				1,417.5			24.6				24.6
Special Naphtha			70.8				70.8			1.4				1.4
Unfinished Oils			(320.9)				(320.9)			(6.4)				(6.4)
Waxes			40.6				40.6			0.8				0.8
Other Wax & Misc.			0.0				0.0			(3.3)				(3.3)
Total Petroleum	1,363.0	756.8	8,688.1	23,072.9	658.0	557.5	35,096.2	25.7	15.0	97.9	421.7	14.0	10.946	585.3
Geothermal					0.016		0.016					0.0328		0.0328
TOTAL (All Fuels)	6,398.0	4,023.0	21,194.3	23,794.8	20,913.3	567.7	76,891.1	98.8	62.9	299.7	432.1	493.9	11.201	1,398.7

*Adjustments include: international bunker fuel consumption (see Table A-8) and carbon stored in products (see Table A-9)
NA (Not Available)

Table A-3: 1994 Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
	Consumption (TBtu)							Emissions (MMTCE) including Adjustments* and Fraction Oxidized						
Fuel Type	**Res.**	**Comm.**	**Ind.**	**Trans.**	**Utility**	**Terr.**	**Total**	**Res.**	**Comm.**	**Ind.**	**Trans.**	**Utility**	**Terr.**	**Total**
Residential Coal	55.5						55.5	1.4						1.4
Commercial Coal		83.5					83.5		2.1					2.1
Industrial Coking Coal			850.6				850.6			21.0				21.0
Industrial Other Coal			1,589.4				1,589.4			41.1				41.1
Coke Imports			23.6				23.6			0.7				0.7
Transportation Coal				0.0			0.0				0.0			0.0
Utility Coal					16,895.2		16,895.2					430.2		430.2
US Territory Coal (bit)						10.2	10.2						0.255	0.3
Total Coal	55.5	83.5	2,463.7	0.0	16,895.2	10.2	19,508.1	1.4	2.1	62.7	0.0	430.2	0.3	496.7
Natural Gas	4,988.3	2,980.8	9,609.3	705.2	3,052.9	NA	21,336.5	71.8	42.9	133.3	10.2	44.0	NA	302.1
Asphalt & Road Oil	0.0	0.0	1,172.9	0.0	0.0		1,172.9	0.0	0.0	(0.0)	0.0	0.0	0.000	(0.0)
Aviation Gasoline	0.0	0.0	0.0	38.1	0.0		38.1	0.0	0.0	0.0	0.7	0.0	0.000	0.7
Distillate Fuel Oil	880.0	464.3	1,108.8	4,175.0	95.2	101.3	6,824.6	17.4	9.2	21.9	80.4	1.9	2.001	132.7
Jet Fuel	0.0	0.0	0.0	3,154.5	0.0	80.7	3,235.2	0.0	0.0	0.0	54.9	0.0	1.546	56.4
Kerosene	64.9	19.5	16.9	0.0	0.0		101.3	1.3	0.4	0.3	0.0	0.0	0.000	2.0
LPG	395.5	69.8	1,996.5	32.2	0.0	9.2	2,503.1	6.7	1.2	12.8	0.5	0.0	0.156	21.3
Lubricants	0.0	0.0	180.9	170.8	0.0	2.1	353.8	0.0	0.0	1.8	1.7	0.0	0.021	3.5
Motor Gasoline	0.0	25.2	191.9	14,214.1	0.0	131.4	14,562.7	0.0	0.5	3.7	273.7	0.0	2.500	280.4
Residual Fuel	0.0	174.6	417.6	896.0	846.6	171.1	2,505.9	0.0	3.7	8.9	4.6	18.0	3.641	38.8
Other Petroleum						72.6	72.6						1.294	1.3
AvGas Blend Components			6.1				6.1			0.1				0.1
Crude Oil			18.7				18.7			0.4				0.4
MoGas Blend Components			0.0				0.0			0.0				0.0
Misc. Products			105.9				105.9			2.1				2.1
Naphtha (<401 deg. F)			398.3				398.3			7.2				7.2
Other Oil (>401 deg. F)			838.6				838.6			16.6				16.6
Pentanes Plus			338.7				338.7			2.4				2.4
Petrochemical Feedstocks			0.0				0.0			(13.6)				(13.6)
Petroleum Coke			793.0		26.3		819.4			19.4		0.7		20.1
Still Gas			1,439.4				1,439.4			25.0				25.0
Special Naphtha			81.1				81.1			1.6				1.6
Unfinished Oils			(279.2)				(279.2)			(5.6)				(5.6)
Waxes			40.6				40.6			0.8				0.8
Other Wax & Misc.			0.0				0.0			(3.5)				(3.5)
Total Petroleum	1,340.4	753.3	8,866.8	22,680.7	968.2	568.5	35,177.9	25.3	14.9	102.2	416.6	20.6	11.159	590.7
Geothermal					0.024		0.024					0.0492		0.0492
TOTAL (All Fuels)	6,384.2	3,817.6	20,939.8	23,385.9	20,916.2	578.7	76,022.4	98.6	60.0	298.1	426.7	494.8	11.414	1,389.6

*Adjustments include: international bunker fuel consumption (see Table A-8) and carbon stored in products (see Table A-9)
NA (Not Available)

Table A-4: 1993 Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
	Consumption (TBtu)							Emissions (MMTCE) including Adjustments* and Fraction Oxidized						
Fuel Type	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total
Residential Coal	56.6						56.6	1.5						1.5
Commercial Coal		85.5					85.5		2.2					2.2
Industrial Coking Coal			839.5				839.5			20.7				20.7
Industrial Other Coal			1,588.0				1,588.0			41.1				41.1
Coke Imports			17.3				17.3			0.5				0.5
Transportation Coal				0.0			0.0				0.0			0.0
Utility Coal					16,841.1		16,841.1					428.7		428.7
US Territory Coal (bit)						8.1	8.1						0.201	0.2
Total Coal	56.6	85.5	2,444.8	0.0	16,841.1	8.1	19,436.1	1.5	2.2	62.2	0.0	428.7	0.2	494.7
Natural Gas	5,097.5	2,995.8	9,387.4	643.1	2,744.1	NA	20,867.9	73.4	43.1	131.0	9.3	39.5	NA	296.3
Asphalt & Road Oil	0.0	0.0	1,149.0	0.0	0.0		1,149.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0
Aviation Gasoline	0.0	0.0	0.0	38.4	0.0		38.4	0.0	0.0	0.0	0.7	0.0	0.000	0.7
Distillate Fuel Oil	912.9	463.9	1,099.7	3,912.9	76.7	92.3	6,558.3	18.0	9.2	21.7	75.2	1.5	1.823	127.5
Jet Fuel	0.0	0.0	0.0	3,028.0	0.0	71.4	3,099.4	0.0	0.0	0.0	52.7	0.0	1.369	54.1
Kerosene	75.6	14.0	13.1	0.0	0.0		102.7	1.5	0.3	0.3	0.0	0.0	0.000	2.0
LPG	398.6	70.3	1,794.4	18.9	0.0	12.8	2,295.1	6.7	1.2	12.0	0.3	0.0	0.217	20.4
Lubricants	0.0	0.0	173.1	163.5	0.0	0.2	336.7	0.0	0.0	1.7	1.6	0.0	0.002	3.4
Motor Gasoline	0.0	29.6	179.4	14,000.5	0.0	115.9	14,325.5	0.0	0.6	3.5	269.3	0.0	2.206	275.5
Residual Fuel	0.0	175.0	451.8	913.4	938.6	153.6	2,632.4	0.0	3.7	9.6	4.2	20.0	3.269	40.7
Other Petroleum						83.2	83.2						1.482	1.5
AvGas Blend Components			0.1				0.1			0.0				0.0
Crude Oil			21.2				21.2			0.4				0.4
MoGas Blend Components			0.0				0.0			0.0				0.0
Misc. Products			94.7				94.7			1.9				1.9
Naphtha (<401 deg. F)			350.6				350.6			6.3				6.3
Other Oil (>401 deg. F)			844.1				844.1			16.7				16.7
Pentanes Plus			332.3				332.3			2.0				2.0
Petrochemical Feedstocks			0.0				0.0			(13.1)				(13.1)
Petroleum Coke			767.3		36.8		804.1			18.9		1.0		19.9
Still Gas			1,430.2				1,430.2			24.8				24.8
Special Naphtha			104.6				104.6			2.1				2.1
Unfinished Oils			(396.0)				(396.0)			(7.9)				(7.9)
Waxes			40.0				40.0			0.8				0.8
Other Wax & Misc.			0.0				0.0			(3.3)				(3.3)
Total Petroleum	1,387.0	752.8	8,449.6	22,075.5	1,052.0	529.5	34,246.5	26.2	14.9	98.3	404.1	22.5	10.368	576.4
Geothermal					0.026		0.026					0.0533		0.0533
TOTAL (All Fuels)	6,541.1	3,834.2	20,281.8	22,718.6	20,637.3	537.5	74,550.5	101.0	60.2	291.5	413.4	490.7	10.569	1,367.5

*Adjustments include: international bunker fuel consumption (see Table A-8) and carbon stored in products (see Table A-9)
NA (Not Available)

Table A-5: 1992 Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
	Consumption (TBtu)							Emissions (MMTCE) including Adjustments* and Fraction Oxidized						
Fuel Type	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total
Residential Coal	56.7						56.7	1.5						1.5
Commercial Coal		85.7					85.7		2.2					2.2
Industrial Coking Coal			867.4				867.4			21.2				21.2
Industrial Other Coal			1,573.1				1,573.1			40.7				40.7
Coke Imports			27.2				27.2			0.7				0.7
Transportation Coal				0.0			0.0				0.0			0.0
Utility Coal					16,192.0		16,192.0					411.8		411.8
US Territory Coal (bit)						8.8	8.8						0.220	0.2
Total Coal	56.7	85.7	2,467.7	0.0	16,192.0	8.8	18,810.9	1.5	2.2	62.6	0.0	411.8	0.2	478.3
Natural Gas	4,821.1	2,884.2	8,996.4	608.4	2,828.5	NA	20,138.6	69.4	41.5	125.8	8.8	40.7	NA	286.2
Asphalt & Road Oil	0.0	0.0	1,102.2	0.0	0.0		1,102.2	0.0	0.0	(0.0)	0.0	0.0	0.000	(0.0)
Aviation Gasoline	0.0	0.0	0.0	41.1	0.0		41.1	0.0	0.0	0.0	0.8	0.0	0.000	0.8
Distillate Fuel Oil	864.9	464.0	1,144.5	3,810.2	67.3	78.7	6,429.6	17.1	9.2	22.6	73.4	1.3	1.554	125.2
Jet Fuel	0.0	0.0	0.0	3,001.3	0.0	65.8	3,067.1	0.0	0.0	0.0	52.3	0.0	1.264	53.5
Kerosene	65.0	11.1	9.8	0.0	0.0		85.9	1.3	0.2	0.2	0.0	0.0	0.000	1.7
LPG	382.5	67.5	1,859.8	18.4	0.0	11.8	2,340.0	6.4	1.1	12.6	0.3	0.0	0.199	20.6
Lubricants	0.0	0.0	170.0	160.5	0.0	0.0	330.5	0.0	0.0	1.7	1.6	0.0	0.000	3.3
Motor Gasoline	0.0	79.5	194.3	13,698.8	0.0	114.4	14,087.0	0.0	1.5	3.7	263.4	0.0	2.176	270.8
Residual Fuel	0.0	191.2	391.3	1,082.0	835.6	154.5	2,654.6	0.0	4.1	8.3	5.5	17.8	3.288	39.0
Other Petroleum						61.4	61.4						1.095	1.1
AvGas Blend Components			0.2				0.2			0.0				0.0
Crude Oil			27.4				27.4			0.5				0.5
MoGas Blend Components			75.7				75.7			1.5				1.5
Misc. Products			100.1				100.1			2.0				2.0
Naphtha (<401 deg. F)			377.3				377.3			6.8				6.8
Other Oil (>401 deg. F)			814.9				814.9			16.1				16.1
Pentanes Plus			322.7				322.7			4.9				4.9
Petrochemical Feedstocks			0.0				0.0			(13.1)				(13.1)
Petroleum Coke			813.1		30.1		843.2			19.0		0.8		19.9
Still Gas			1,447.6				1,447.6			25.1				25.1
Special Naphtha			104.6				104.6			2.1				2.1
Unfinished Oils			(355.0)				(355.0)			(7.1)				(7.1)
Waxes			37.3				37.3			0.7				0.7
Other Wax & Misc.			0.0				0.0			(3.3)				(3.3)
Total Petroleum	1,312.4	813.3	8,637.7	21,812.3	933.0	486.6	33,995.3	24.8	16.1	104.3	397.3	19.9	9.575	572.0
Geothermal					0.028		0.028					0.0574		0.0574
TOTAL (All Fuels)	6,190.2	3,783.2	20,101.8	22,420.7	19,953.5	495.5	72,944.8	95.7	59.9	292.6	406.1	472.5	9.795	1,336.6

*Adjustments include: international bunker fuel consumption (see Table A-8) and carbon stored in products (see Table A-9)
NA (Not Available)

Table A-6: 1991 Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
	Consumption (TBtu)							Emissions (MMTCE) including Adjustments* and Fraction Oxidized						
Fuel Type	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total
Residential Coal	56.3						56.3	1.4						1.4
Commercial Coal		84.5					84.5		2.2					2.2
Industrial Coking Coal			907.3				907.3			22.6				22.6
Industrial Other Coal			1,629.2				1,629.2			42.0				42.0
Coke Imports			8.9				8.9			0.2				0.2
Transportation Coal				0.0			0.0				0.0			0.0
Utility Coal					16,012.4		16,012.4					407.2		407.2
US Territory Coal (bit)						7.0	7.0						0.175	0.2
Total Coal	56.3	84.5	2,545.4	0.0	16,012.4	7.0	18,705.6	1.4	2.2	64.8	0.0	407.2	0.2	475.8
Natural Gas	4,685.0	2,807.7	8,637.2	621.5	2,853.6	NA	19,605.0	67.5	40.4	120.0	8.9	41.1	NA	277.9
Asphalt & Road Oil	0.0	0.0	1,076.5	0.0	0.0		1,076.5	0.0	0.0	(0.0)	0.0	0.0	0.000	(0.0)
Aviation Gasoline	0.0	0.0	0.0	41.7	0.0		41.7	0.0	0.0	0.0	0.8	0.0	0.000	0.8
Distillate Fuel Oil	831.5	481.6	1,139.2	3,677.6	80.0	72.2	6,282.1	16.4	9.5	22.5	70.5	1.6	1.426	121.9
Jet Fuel	0.0	0.0	0.0	3,025.0	0.0	80.8	3,105.8	0.0	0.0	0.0	53.0	0.0	1.551	54.6
Kerosene	72.3	12.1	11.4	0.0	0.0		95.8	1.4	0.2	0.2	0.0	0.0	0.000	1.9
LPG	389.5	68.7	1,749.3	19.9	0.0	13.7	2,241.1	6.5	1.2	10.9	0.3	0.0	0.233	19.1
Lubricants	0.0	0.0	166.7	157.5	0.0	0.0	324.2	0.0	0.0	1.7	1.6	0.0	0.000	3.2
Motor Gasoline	0.0	85.0	193.3	13,502.6	0.0	117.3	13,898.2	0.0	1.6	3.7	259.5	0.0	2.232	267.0
Residual Fuel	0.0	213.2	335.9	1,031.9	1,076.1	135.0	2,792.1	0.0	4.5	7.1	5.5	22.9	2.872	42.9
Other Petroleum						122.7	122.7						2.186	2.2
AvGas Blend Components			(0.1)				(0.1)			(0.0)				(0.0)
Crude Oil			38.9				38.9			0.8				0.8
MoGas Blend Components			(25.9)				(25.9)			(0.5)				(0.5)
Misc. Products			152.6				152.6			3.1				3.1
Naphtha (<401 deg. F)			298.9				298.9			5.4				5.4
Other Oil (>401 deg. F)			827.3				827.3			16.3				16.3
Pentanes Plus			294.0				294.0			4.7				4.7
Petrochemical Feedstocks			0.0				0.0			(12.2)				(12.2)
Petroleum Coke			700.2		21.7		722.0			17.1		0.6		17.7
Still Gas			1,426.6				1,426.6			24.7				24.7
Special Naphtha			88.0				88.0			1.7				1.7
Unfinished Oils			(450.2)				(450.2)			(9.0)				(9.0)
Waxes			35.1				35.1			0.7				0.7
Other Wax & Misc.			0.0				0.0			(4.4)				(4.4)
Total Petroleum	1,293.3	860.6	8,057.8	21,456.2	1,177.8	541.7	33,387.5	24.4	17.1	94.5	391.1	25.1	10.500	562.6
Geothermal					0.028		0.028					0.0574		0.0574
TOTAL (All Fuels)	6,034.6	3,752.8	19,240.4	22,077.7	20,043.8	548.7	71,698.1	93.3	59.7	279.3	400.1	473.5	10.675	1,316.4

*Adjustments include: international bunker fuel consumption (see Table A-8) and carbon stored in products (see Table A-9)
NA (Not Available)

Table A-7: 1990 Energy Consumption Data and CO_2 Emissions from Fossil Fuel Combustion by Fuel Type

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*
	Consumption (TBtu)							Emissions (MMTCE) including Adjustments* and Fraction Oxidized						
Fuel Type	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total	Res.	Comm.	Ind.	Trans.	Utility	Terr.	Total
Residential Coal	61.9						61.9	1.6						1.6
Commercial Coal		92.9					92.9		2.4					2.4
Industrial Coking Coal			1,041.8				1,041.8			25.9				25.9
Industrial Other Coal			1,646.1				1,646.1			42.4				42.4
Coke Imports			4.8				4.8			0.1				0.1
Transportation Coal				0.0			0.0				0.0			0.0
Utility Coal					16,087.8		16,087.8					409.0		409.0
US Territory Coal (bit)						4.9	4.9						0.122	0.1
Total Coal	61.9	92.9	2,692.7	0.0	16,087.8	4.9	18,940.2	1.6	2.4	68.5	0.0	409.0	0.1	481.6
Natural Gas	4,518.7	2,698.1	8,519.7	682.4	2,861.4	NA	19,280.3	65.1	38.8	118.2	9.8	41.2	NA	273.1
Asphalt & Road Oil	0.0	0.0	1,170.2	0.0	0.0		1,170.2	0.0	0.0	0.0	0.0	0.0	0.000	0.0
Aviation Gasoline	0.0	0.0	0.0	45.0	0.0		45.0	0.0	0.0	0.0	0.8	0.0	0.000	0.8
Distillate Fuel Oil	837.4	487.0	1,180.9	3,830.5	86.3	73.9	6,496.0	16.5	9.6	23.3	73.4	1.7	1.459	126.1
Jet Fuel	0.0	0.0	0.0	3,129.5	0.0	63.5	3,193.0	0.0	0.0	0.0	55.0	0.0	1.220	56.3
Kerosene	63.9	11.8	12.3	0.0	0.0		88.0	1.2	0.2	0.2	0.0	0.0	0.000	1.7
LPG	365.0	64.4	1,607.7	21.8	0.0	14.4	2,073.3	6.1	1.1	10.9	0.4	0.0	0.244	18.7
Lubricants	0.0	0.0	186.3	176.0	0.0	0.8	363.1	0.0	0.0	1.9	1.8	0.0	0.008	3.6
Motor Gasoline	0.0	110.6	184.1	13,577.1	0.0	100.8	13,972.6	0.0	2.1	3.5	260.9	0.0	1.918	268.5
Residual Fuel	0.0	233.1	417.2	1,030.2	1,139.4	121.8	2,941.7	0.0	5.0	8.9	6.7	24.2	2.590	47.4
Other Petroleum						85.2	85.2						1.518	1.5
AvGas Blend Components			0.2				0.2			0.0				0.0
Crude Oil			50.9				50.9			1.0				1.0
MoGas Blend Components			53.7				53.7			1.0				1.0
Misc. Products			137.8				137.8			2.8				2.8
Naphtha (<401 deg. F)			347.8				347.8			6.2				6.2
Other Oil (>401 deg. F)			753.9				753.9			14.9				14.9
Pentanes Plus			250.3				250.3			3.3				3.3
Petrochemical Feedstocks			0.0				0.0			(12.1)				(12.1)
Petroleum Coke			719.9		24.7		744.6			17.3		0.7		18.0
Still Gas			1,473.2				1,473.2			25.5				25.5
Special Naphtha			107.1				107.1			2.1				2.1
Unfinished Oils			(369.0)				(369.0)			(7.4)				(7.4)
Waxes			33.3				33.3			0.7				0.7
Other Wax & Misc.			0.0				0.0			(3.9)				(3.9)
Total Petroleum	1,266.3	906.9	8,317.9	21,810.1	1,250.4	460.3	34,011.9	23.9	18.0	100.2	399.0	26.6	8.957	576.7
Geothermal					0.029		0.029					0.0595		0.0595
TOTAL (All Fuels)	5,846.9	3,697.9	19,530.3	22,492.5	20,199.6	465.2	72,232.4	90.6	59.2	286.8	408.9	476.9	9.079	1,331.4

*Adjustments include: international bunker fuel consumption (see Table A-8) and carbon stored in products (see Table A-9)
NA (Not Available)

Table A-8: 1996 Emissions From International Bunker Fuel Consumption

1	2	3	4	5	6
Fuel Type	Bunker Fuel Consumption (TBtu)	Carbon Content Coefficient (MMTCE/QBtu)[3]	Carbon Content (MMTCE)	Fraction Oxidized	Emissions (MMTCE)
Distillate Fuel	109	19.95	2	0.99	2
Jet Fuel	312	19.33	6	0.99	6
Residual Fuel	665	21.49	14	0.99	14
Total	1,085		22.5		22.3

Table A-9: 1996 Carbon Stored In Products

1	2	3	4	5	6	7	8	9	10
	Non-Fuel Use (TBtu)		Carbon Content Coefficient	Carbon Content (MMTCE)		Fraction Sequestered	Carbon Stored (MMTCE)		
Fuel Type	Ind.	Trans.	(MMTCE/QBtu)	Ind.	Trans.		Ind.	Trans.	Total
Industrial Coking Coal	28		25.53	0.7		0.75	0.532		0.532
Natural Gas	381		14.47	6		1.00	5.520		5.520
Asphalt & Road Oil	1,176		20.62	24		1.00	24.248		24.248
Distillate Fuel Oil	[a]		19.95	0		[a]	[a]		[a]
LPG	1,699		16.99	29		0.80	23.088		23.088
Lubricants	173	163	20.24	3	3	0.50	1.746	1.649	3.395
Residual Fuel	[a]		21.49	0		[a]	[a]		[a]
Naphtha (<401 deg. F)	[b]		18.14	0		[b]	[b]		[b]
Other Oil (>401 deg. F)	[b]		19.95	0		[b]	[b]		[b]
Pentanes Plus	319		18.24	6		0.80	4.651		4.651
Petrochemical Feedstocks	1,204		19.37	21		0.75	13.812		13.812
Petroleum Coke	208		27.85	6		0.50	2.897		2.897
Special Naphtha	75		19.86	1		0.00	0.000		0.000
Other Wax & Misc.	192		19.81	4		1.00	3.417		3.417
Total	5,453	163		101	3		79.9	1.6	81.6

[a] Non-fuel use values of distillate fuel and residual fuel were relatively small and included in the "Other Waxes and Misc." category.
[b] Non-fuel use values of Naphtha (<401 deg. F) and Other Oil (>401 deg. F) are reported in the "Petrochemical Feedstocks" category.

[3] One QBtu is one quadrillion Btu, or 10^{15} Btu. This unit is commonly referred to as a "Quad."

Table A-10: Key Assumptions for Estimating Carbon Dioxide Emissions

Fuel Type	Carbon Content Coefficient (MMTCE/QBtu)	Fraction Oxidized
Coal		
Residential Coal	[a]	0.99
Commercial Coal	[a]	0.99
Industrial Coking Coal	[a]	0.99
Industrial Other Coal	[a]	0.99
Coke Imports	27.85	0.99
Transportation Coal	NC	0.99
Utility Coal	[a]	0.99
U.S. Territory Coal (bit)	25.14	0.99
Natural Gas	14.47	0.995
Petroleum		
Asphalt & Road Oil	20.62	0.99
Aviation Gasoline	18.87	0.99
Distillate Fuel Oil	19.95	0.99
Jet Fuel	[a]	0.99
Kerosene	19.72	0.99
LPG	[a]	0.99
Lubricants	20.24	0.99
Motor Gasoline	[a]	0.99
Residual Fuel	21.49	0.99
Other Petroleum		
AvGas Blend Components	18.87	0.99
Crude Oil	[a]	0.99
MoGas Blend Components	19.39	0.99
Misc. Products	20.23	0.99
Naphtha (<401 deg. F)	18.14	0.99
Other Oil (>401 deg. F)	19.95	0.99
Pentanes Plus	18.24	0.99
Petrochemical Feedstocks	19.37	0.99
Petroleum Coke	27.85	0.99
Still Gas	17.51	0.99
Special Naphtha	19.86	0.99
Unfinished Oils	20.23	0.99
Waxes	19.81	0.99
Other Wax & Misc.	19.81	0.99
Geothermal	2.05	NA

Sources: Carbon Coefficients and stored carbon from EIA. Combustion efficiency for coal from Bechtel (1993) and for petroleum and natural gas from IPCC (IPCC/UNEP/OECD/IEA 1997, vol. 2).

NA (Not Applicable)

NC (Not Calculated)

[a] These coefficients vary annually due to fluctuations in fuel quality (see Table A-11).

Table A-11: Annually Variable Carbon Content Coefficients by Year (MMTCE/QBtu)

Fuel Type	1990	1991	1992	1993	1994	1995	1996
Residential Coal	25.92	26.00	26.13	25.97	25.95	26.00	26.00
Commercial Coal	25.92	26.00	26.13	25.97	25.95	26.00	26.00
Industrial Coking Coal	25.51	25.51	25.51	25.51	25.52	25.53	25.53
Industrial Other Coal	25.58	25.59	25.62	25.61	25.63	25.63	25.63
Utility Coal	25.68	25.69	25.69	25.71	25.72	25.74	25.74
LPG	16.99	16.98	16.99	16.97	17.01	17.00	16.99
Motor Gasoline	19.41	19.41	19.42	19.43	19.45	19.38	19.38
Jet Fuel	19.40	19.40	19.39	19.37	19.35	19.34	19.33
Crude Oil	20.14	20.16	20.20	20.20	20.19	20.21	20.23

Source: EIA

Table A-12: Electricity Consumption by End-Use Sector (Billion Kilowatt-hours)

End-Use Sector	1990	1991	1992	1993	1994	1995	1996
Residential	924	955	936	995	1,008	1,043	1,078
Commercial	839	856	851	886	914	954	985
Industrial	946	947	973	977	1,008	1,013	1,017
Transportation	4	4	4	4	4	4	4
U.S. Territories*	-	-	-	-	-	-	-
Total	2,713	2,762	2,764	2,862	2,934	3,014	3,084

*EIA electric utility fuel consumption data does not include the U.S. territories.
- Not applicable
Source: EIA