Emissions & Storage Factors for Non-Energy Uses Natural Gas, 1980-2010

Climate Mitigation Services
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3-Feb-12 Note: the EPA and EIA data on natural gas in non-energy uses differ - (EPA 2009: 0.366 Qbtu/EIA 2009: 0.620 Qbtu, or 59%)
CMS applies the EPA sequestration rate 0.59 (see Table A-252 at right). This factor may be revised.
The EPA rate suggests an average sequestration rate of 1.711 percent.
However, the EPA cites 0.366 Q Btu of natural gas as non-energy use, whereas EIA shows 0.62 Q Btu (both for 2009).
Normalizing to EPA non-energy use suggests a sequestration rate of 34.25 percent on non-energy (0.994% of all gas uses).

EIA, Table 1.15 Fossil Fuel Consumption for Nonfuel Use, 1980-2010

Note: This table amends EIA data on non-energy uses to show storage & emissions

Natural Gas

Year	Total Non-fuel Non-energy use	Nitrogenous Fertilizers Non-energy use	Nitrogenous Fertilizers Amnt Emitted 42.0%	Other, e.g, methanol Non-energy use	Other, e.g, methanol Amnt Emitted 42.0%	Total Non-fuel Non-energy use	Total Non-fuel Amnt Emitted	Total Natural Gas Supplied	Non-energy uses, Percent of total supplied	Non-energy emissions, Percent of total supplied	Non-energy storage Percent of total supplied
Year	EIA							Billion cubic feet (Bcf)			
1980	639	320	134	320	134	639	268	19,877	3.2%	1.4%	1.86%
1981	468	234	98	234	98	468	197	19,404	2.4%	1.0%	1.40%
1982	403	202	85	202	85	403	169	18,001	2.2%	0.9%	1.30%
1983	390	195	82	195	82	390	164	16,835	2.3%	1.0%	1.34%
1984	441	221	93	221	93	441	185	17,951	2.5%	1.0%	1.42%
1985	500	250	105	250	105	500	210	17,281	2.9%	1.2%	1.68%
1986	423	212	89	212	89	423	178	16,221	2.6%	1.1%	1.51%
1987	474	237	100	237	100	474	199	17,211	2.8%	1.2%	1.60%
1988	554	277	116	277	116	554	233	18,030	3.1%	1.3%	1.78%
1989	489	245	103	245	103	489	205	19,119	2.6%	1.1%	1.48%
1990	547	274	115	274	115	547	230	19,174	2.9%	1.2%	1.65%
1991	573	287	120	287	120	573	241	19,562	2.9%	1.2%	1.70%
1992	603	302	127	302	127	603	253	20,228	3.0%	1.3%	1.73%
1993	618	309	130	309	130	618	260	20,790	3.0%	1.2%	1.72%
1994	673	337	141	337	141	673	283	21,247	3.2%	1.3%	1.84%
1995	668	334	140	334	140	668	281	22,207	3.0%	1.3%	1.74%
1996	681	341	143	341	143	681	286	22,609	3.0%	1.3%	1.75%
1997	706	353	148	353	148	706	297	22,737	3.1%	1.3%	1.80%
1998	762	381	160	381	160	762	320	22,246	3.4%	1.4%	1.99%
1999	752	376	158	376	158	752	316	22,405	3.4%	1.4%	1.95%
2000	724	362	152	362	152	724	304	23,333	3.1%	1.3%	1.80%
2001	626	313	131	313	131	626	263	22,239	2.8%	1.2%	1.63%
2002	657	329	138	329	138	657	276	23,007	2.9%	1.2%	1.66%
2003	611	306	128	306	128	611	257	22,277	2.7%	1.2%	1.59%
2004	607	304	127	304	127	607	255	22,389	2.7%	1.1%	1.57%
2005	629	315	132	315	132	629	264	22,011	2.9%	1.2%	1.66%
2006	627	314	132	314	132	627	263	21,685	2.9%	1.2%	1.68%
2007	665	333	140	333	140	665	279	23,097	2.9%	1.2%	1.67%
2008	642	321	135	321	135	642	270	23,268	2.8%	1.2%	1.60%
2009	605	303	127	303	127	605	254	22,840	2.6%	1.1%	1.54%
2010	626	313	131	313	131	626	263	24,133	2.6%	1.1%	1.50%

Average carbon storage rate 1980-2010 for non-energy uses of natural gas (USA) - EIA approach 1.650%

Natural Gas

Year	Non-energy use	Carbon Coefficent	Carbon Content	Quant emitted 41.0%	Quantity stored 59.0%	Total natural gas emissions	Non-energy emission rate Percent of total emissions	Non-energy storage rate Percent of total emissions
	QBtu	MtC/QBtu	MtC	MtCO2	MtCO2	MtCO2	Percent	Percent
	EIA	EPA	calculated	calculated	calculated	EIA	calculated	calculated
1980	0.65	14.45	9.39	14.12	20.32	1,063	1.33%	1.91%
1981	0.48	14.45	6.94	10.43	15.01	1,036	1.01%	1.45%
1982	0.41	14.45	5.92	8.91	12.82	963	0.92%	1.33%
1983	0.40	14.45	5.78	8.69	12.51	901	0.96%	1.39%
1984	0.45	14.45	6.50	9.78	14.07	962	1.02%	1.46%
1985	0.52	14.45	7.51	11.30	16.26	926	1.22%	1.76%
1986	0.44	14.45	6.36	9.56	13.76	866	1.10%	1.59%
1987	0.49	14.45	7.08	10.65	15.32	920	1.16%	1.67%
1988	0.57	14.45	8.24	12.38	17.82	962	1.29%	1.85%
1989	0.50	14.45	7.23	10.86	15.63	1,022	1.06%	1.53%
1990	0.56	14.45	8.09	12.17	17.51	1,025	1.19%	1.71%
1991	0.59	14.45	8.53	12.82	18.45	1,047	1.22%	1.76%
1992	0.62	14.45	8.96	13.47	19.39	1,082	1.25%	1.79%
1993	0.64	14.46	9.25	13.91	20.02	1,110	1.25%	1.80%
1994	0.69	14.46	9.98	15.00	21.58	1,134	1.32%	1.90%
1995	0.69	14.46	9.98	15.00	21.59	1,184	1.27%	1.82%
1996	0.70	14.46	10.12	15.22	21.90	1,205	1.26%	1.82%
1997	0.72	14.46	10.41	15.65	22.52	1,211	1.29%	1.86%
1998	0.79	14.44	11.41	17.15	24.68	1,189	1.44%	2.08%
1999	0.77	14.46	11.13	16.74	24.09	1,192	1.40%	2.02%
2000	0.74	14.47	10.71	16.10	23.17	1,241	1.30%	1.87%
2001	0.64	14.46	9.25	13.91	20.02	1,187	1.17%	1.69%
2002	0.68	14.46	9.83	14.78	21.27	1,229	1.20%	1.73%
2003	0.63	14.44	9.10	13.68	19.68	1,191	1.15%	1.65%
2004	0.62	14.46	8.97	13.48	19.40	1,194	1.13%	1.62%
2005	0.65	14.46	9.40	14.13	20.34	1,175	1.20%	1.73%
2006	0.64	14.46	9.25	13.91	20.02	1,157	1.20%	1.73%
2007	0.68	14.46	9.83	14.78	21.27	1,235	1.20%	1.72%
2008	0.66	14.46	9.54	14.35	20.65	1,243	1.15%	1.66%
2009	0.62	14.46	8.97	13.48	19.40	1,218	1.11%	1.59%
2010	0.64	14.46	9.25	13.91	20.02	1,285	1.08%	1.56%
	EPA non-energy use in 2009 of 0.366 Qbtu and 0.222 Qbtu in 2010.							
averages:	0.61	14.45	8.80	13.24	19.05	1,108	1.19%	1.71%

simple 31-yr average

Average carbon storage rate 1980-2010 for non-energy uses of natural gas (USA) 1.711%

Carbon storage rate in CDIAC's global emissions database 1751-2010 2.000%

Average of CDIAC & US average 1980-2010 carbon storage rate 1.856%

linked to "Gas Emissions Factor Calc"

Table 1-5
Estimation of Carbon Stored in Products

	1	2	3	4	5	6	7
	Estimated Fuel Quantities[a]	Conversion Factor	Estimated Fuel Quantities[b]	Emission Factor	Carbon Content[c]	Fraction Carbon Stored	Carbon Stored[d]
Product/Fuel[e]	(Original Units)	TJ/Units	(TJ)	(t C/TJ)	(Gg C)		(Gg C)
Lubricants	calc	Table 1-3	calc	Table 1-1	calc	0.50	calc
Bitumen	calc	Table 1-3	calc	Table 1-1	calc	1.0	calc
Coal Oils and Tars from Coking Coal	calc[f]	Table 1-3	calc	Table 1-1[g]	calc	0.75	calc
Naphtha as Feedstock	calc	Table 1-3	calc	Table 1-1	calc	0.75	calc
Gas/Diesel Oil as Feedstock	calc	Table 1-3	calc	Table 1-1	calc	0.50	calc
Natural Gas as Feedstock	calc	Table 1-3	calc	Table 1-1	calc	0.33	calc
LPG as Feedstock	calc	Table 1-3	calc	Table 1-1	calc	0.80	calc
Ethane as Feedstock	calc	Table 1-3	calc	Table 1-1	calc	0.80	calc

(a) Either Apparent Consumption plus domestic (manufactured) production, or Feedstock Use.

(b) Estimated Fuel Quantities in TJ (Col. 3) equals Estimated Fuel Quantities (Col. 1) times a Conversion Factor (Col. 2).

(c) Carbon Content (Col. 5) equals Estimated Fuel Quantities in TJ (Col. 3) times an Emission Factor (Col. 4).

(d) Carbon Stored (Col. 7) equals Carbon Content (Col. 5) times Fraction Carbon Stored (Col. 6) divided by 10^3.

(e) This is an incomplete list of products/fuels which account for the majority of carbon stored. Where data are available for other fuels, the estimation of stored carbon is strongly encouraged.

(f) Use 6% of apparent consumption of Coking Coal.

(g) Use the emission factor for coking coal (25.8 t C/TJ).

IPCC (1996) Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual, Volume 3, Ener

Table 1-5 (Estimation of Carbon Stored in Products) and Table 1-6 (Fraction of Carbon Oxidised)

Table 1-6
Fraction of Carbon Oxidised (Recommended Default Assumptions)

Coal[a]	0.98
Oil and Oil Products	0.99
Gas	0.995
Peat for electricity generation[b]	0.99

(a) This figure is a global average but varies for different types of coal, and can be as low as 0.91.

(b) The fraction for peat used in households may be much lower.

IPCC (1996) Table 1-6.

Note: these oxidation factors are superceeded by full oxidation in the 2006 Guidelines

Table A-256: 2010 Non-Energy Carbon Stored in Products

Fuel Type	Consumption for Non-Energy Use (TBtu)	Carbon Coefficients (Tg Carbon/QBtu)	Carbon Content (Tg Carbon)	Fraction Sequestered	Carbon Stored (Tg CO_2 Eq.)
Coal	64.9	25.61	1.66	0.10	**0.6**
Natural Gas	221.9	14.46	3.21	0.59	**7.0**
Asphalt & Road Oil	877.8	20.55	18.04	1.00	**65.9**
LPG	1,545.8	17.06	26.37	0.59	**57.4**
Lubricants	291.7	20.20	5.89	0.09	**2.0**
Pentanes Plus	103.6	19.10	1.98	0.59	**4.3**
Petrochemical Feedstocks	[a]	[a]	[a]	[a]	**43.1**
Petroleum Coke	3.0	27.85	0.08	0.30	**0.1**
Special Naphtha	25.5	19.74	0.50	0.59	**1.1**
Waxes/Misc.	[a]	[a]	[a]	[a]	**1.3**
Misc. U.S. Territories Petroleum	[a]	[a]	[a]	[a]	**0.4**
Total					**183.1**

[a] Values for Misc. U.S. Territories Petroleum, Petrochemical Feedstocks and Waxes/Misc. are not shown because these categories are aggregates of numerous smaller components.

Note: Totals may not sum due to independent rounding.

Table A-257: 2010 Reference Approach CO_2 Emissions from Fossil Fuel Consumption (Tg CO_2 Eq. unless otherwise noted)

Fuel Category	Potential Emissions	Carbon Sequestered	Net Emissions	Fraction Oxidized	Total Emissions
Coal	1,898.9	0.6	1,898.3	100.0%	1,898.3
Petroleum	2,367.2	175.5	2,191.7	100.0%	2,191.7
Natural Gas	1,297.1	7.0	1,290.1	100.0%	1,290.1
Total	**5,563.2**	**183.1**	**5,380.1**	-	**5,380.1**

Note: Totals may not sum due to independent rounding.

Table A-252: 2009 Non-Energy Carbon Stored in Products; Table A-253: Sequestered CO2 and Oxidation factors

U.S. EPA (2012) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2010, (Draft),

Annex 4: IPCC Reference Approach for Estimating CO2 Emissions from Fossil Fuel Combustion,

Table A-256: 2010 Non-Energy Carbon Stored in Products.

Table 3-19: CO_2 Emissions from Non-Energy Use Fossil Fuel Consumption (Tg CO_2 Eq.)

Year	1990	2000	2005	2006	2007	2008	2009	2010
Potential Emissions	307.2	380.1	375.9	367.1	355.6	333.1	297.3	302.5
C Stored	191.3	237.7	236.3	229.1	225.2	198.0	179.0	183.1
Emissions as a % of Potential	38%	37%	37%	38%	37%	41%	40%	39%
Emissions	**115.8**	**142.5**	**139.6**	**138.0**	**130.4**	**135.0**	**118.2**	**119.4**

U.S. EPA (2012) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2010, (Draft),

3.2. Carbon Emitted from Non-Energy Uses of Fossil Fuels (IPCC Source 48 Category 1A),

Table 3-19: CO2 Emissions from Non-Energy Use Fossil Fuel Consumption (Tg CO2 Eq.)

Table 1.15 Fossil Fuel Consumption for Nonfuel Use Estimates, Selected Years, 1980-2010

Year	Petroleum Products: Asphalt and Road Oil	Liquefied Petroleum Gases	Pentanes Plus	Lubricants	Petro-chemical Feedstocks	Petroleum Coke	Special Naphthas	Other [1]	Total	Natural Gas	Coal	Total	Percent of Total Energy Consumption
Physical Units [2]													
1980	145	230	([3])	58	253	24	37	58	805	639	2.4	--	--
1985	156	265	13	53	144	15	30	41	718	500	1.1	--	--
1990	176	340	18	60	199	R20	20	39	R873	R547	.6	--	--
1991	162	394	10	53	203	R17	17	44	R900	573	.6	--	--
1992	166	397	13	54	214	R29	20	35	R929	603	1.2	--	--
1993	174	389	60	55	216	R13	20	R35	R962	618	.9	--	--
1994	176	437	56	58	224	R13	15	35	R1,015	673	.9	--	--
1995	178	450	66	57	215	R12	13	R33	R1,025	668	.9	--	--
1996	177	470	69	55	217	R15	14	R33	R1,050	681	.9	--	--
1997	184	473	65	58	250	R6	14	R34	R1,085	706	.9	--	--
1998	190	494	44	61	252	R25	20	39	R1,126	762	.8	--	--
1999	200	520	57	62	238	R36	28	37	R1,177	752	.8	--	--
2000	192	479	51	61	243	R16	19	R38	R1,099	R724	.8	--	--
2001	189	445	44	56	214	R29	15	R39	R1,031	R626	.7	--	--
2002	187	465	37	55	229	R24	20	38	R1,055	657	.7	--	--
2003	184	441	37	51	247	R20	15	R36	R1,031	611	.7	--	--
2004	196	453	37	52	287	R36	10	R34	R1,106	R607	.7	--	--
2005	199	428	33	51	266	R31	12	R34	R1,054	R629	.7	--	--
2006	185	440	23	42	265	R35	13	41	R1,044	R627	.6	--	--
2007	180	449	30	52	242	R33	15	40	R1,041	R665	.6	--	--
2008	152	421	25	48	210	R37	16	41	R951	R642	.6	--	--
2009	130	R455	R21	43	R185	29	9	41	R914	R605	.4	--	--
2010[P]	132	474	23	48	195	12	5	43	932	626	.6	--	--
Quadrillion Btu													
1980	0.96	0.78	([3])	0.35	1.43	0.14	0.19	0.34	4.19	0.65	0.08	4.92	6.3
1985	1.03	.90	.06	.32	.82	.09	.16	.24	3.63	.52	.03	4.18	5.5
1990	1.17	1.18	.08	.36	1.12	R.12	.11	.23	R4.38	R.56	.02	R4.96	5.9
1991	1.08	1.37	.04	.32	1.15	R.11	.09	.26	R4.42	.59	.02	R5.03	6.0
1992	1.10	1.39	.06	.33	1.20	R.17	.10	R.21	R4.57	.62	.04	R5.23	R6.1
1993	1.15	1.35	.28	.34	1.22	R.08	.10	.20	R4.72	.64	.03	R5.38	6.2
1994	1.17	1.54	.26	.35	1.26	R.08	.08	.20	R4.95	.69	.03	R5.67	6.4
1995	1.18	1.58	.30	.35	1.21	R.08	.07	.20	R4.96	.69	.03	R5.68	R6.2
1996	1.18	1.64	.32	.34	1.21	R.09	.07	.20	R5.04	.70	.03	R5.77	R6.1
1997	1.22	1.66	.30	.35	1.40	R.04	.07	R.20	R5.24	R.72	.03	R6.00	R6.3
1998	1.26	1.73	.20	.37	1.40	R.15	.11	.23	R5.46	.79	.03	R6.27	R6.6
1999	1.32	1.81	.26	.37	1.33	R.22	.15	R.22	R5.68	.77	.03	R6.48	R6.7
2000	1.28	1.66	.24	.37	1.35	R.10	.10	R.22	R5.30	.74	.03	R6.07	R6.1
2001	1.26	1.55	.20	.34	1.19	R.17	.08	R.23	R5.02	R.64	.02	R5.68	5.9
2002	1.24	1.61	.17	.33	1.27	R.15	.10	.22	R5.10	.68	.02	R5.80	R5.9
2003	1.22	1.54	.17	.31	1.37	R.12	.08	R.21	R5.02	.63	.02	R5.68	5.8
2004	1.30	1.57	.17	.31	1.59	R.22	.05	R.20	R5.42	R.62	.02	R6.07	6.1
2005	1.32	1.49	.15	.31	1.47	R.19	.06	R.20	R5.19	R.65	.02	R5.86	R5.8
2006	1.26	1.52	.11	.25	1.48	R.21	.07	.24	R5.14	R.64	.02	R5.81	R5.8
2007	1.20	1.54	.14	.31	1.35	R.20	.08	.24	R5.06	R.68	.02	R5.76	5.7
2008	1.01	1.45	.12	.29	1.17	R.23	.08	.24	R4.59	.66	.02	R5.27	5.3
2009	.87	R1.54	R.10	.26	R1.03	R.18	R.05	.24	R4.28	R.62	.01	R4.91	R5.2
2010[P]	.88	1.61	.11	.29	1.09	.07	.03	.25	4.33	.64	.02	4.99	5.1

[1] Distillate fuel oil, residual fuel oil, waxes, and miscellaneous products.
[2] Petroleum—million barrels; natural gas—billion cubic feet; and coal—million short tons.
[3] Included in "Liquefied Petroleum Gases."
R=Revised. P=Preliminary. -- =Not applicable.

Notes: • Estimates of consumption for nonfuel use shown in this table are included in total energy consumption (see Table 1.3). • See Note 2, "Nonfuel Use of Fossil Fuels," at end of section. • Because of changes in methodology, data series may be revised annually. • Estimates of nonfuel use in this table are considered industrial uses with the exception of approximately half of the lubricants which are considered transportation use. • Totals may not equal sum of components due to independent rounding.

Web Pages: • See http://www.eia.gov/totalenergy/data/annual/#summary for all data beginning in 1980.
• For related information, see http://www.eia.gov/environment/.

Sources: **Petroleum Products:** • 1980—U.S. Energy Information Administration (EIA), Energy Data Reports, *Petroleum Statement, Annual* and *Sales of Liquefied Petroleum Gases and Ethane in 1980.* • 1981 forward—EIA, *Petroleum Supply Annual*, annual reports, and unpublished data. **Natural Gas:** • 1980—Bureau of the Census, 1980 Survey of Manufactures, *Hydrocarbon, Coal, and Coke Materials Consumed.* • 1981 forward—U.S. Department of Commerce. **Coal:** • 1980 forward—EIA estimates based on the methodology underlying the nonfuel emissions calculations in EIA's *Emissions of Greenhouse Gases in the United States 2008*. **Percent of Total Energy Consumption:** Derived by dividing total by total consumption on Table 1.3.

U.S. Energy Information Administration (2011) Annual Energy Review 2010, Table 1.15. Source of data in "Natural Gas" table at page 1.

Note: EIA revised natural gas non-energy uses in Oct2011 for some years, e.g., 1981-1987, which are used in "Natural Gas."

See the EIA (2012) AER for 2011 at right for updated table 1.15: Non-Combustion Use of Fossil Fuels, 1980-2011.

Table 1.15 Non-Combustion Use of Fossil Fuels, Selected Years, 1980-2011

Year	Petroleum Products: Asphalt and Road Oil	Liquefied Petroleum Gases [1]	Lubricants	Petrochemical Feedstocks [2]	Petroleum Coke	Special Naphthas	Other [3]	Total	Natural Gas [4]	Coal	Total	Percent of Total Energy Consumption
Physical Units [5]												
1980	145	230	58	253	R14	37	58	R795	639	2.4	--	--
1985	156	R278	53	144	R16	30	41	R719	500	1.1	--	--
1990	176	R373	60	199	20	20	39	R887	R567	.6	--	--
1991	162	R436	53	203	17	17	44	R922	573	.6	--	--
1992	166	R448	54	214	R28	20	35	R966	R606	1.2	--	--
1993	174	R436	55	216	R18	20	35	R955	R640	.9	--	--
1994	176	R483	56	224	R21	15	35	R1,013	673	.9	--	--
1995	178	R479	57	215	R20	13	33	R996	R695	.9	--	--
1996	177	R502	55	217	R20	14	33	R1,019	R718	.9	--	--
1997	184	R501	58	250	R15	14	34	R1,056	R740	.9	--	--
1998	190	R485	61	252	25	20	39	R1,073	762	.8	--	--
1999	200	R566	62	238	36	28	37	R1,166	R736	.8	--	--
2000	192	R545	61	243	16	19	38	R1,114	R710	.8	--	--
2001	189	R492	56	214	29	15	39	R1,034	R683	.7	--	--
2002	187	R526	55	229	24	20	38	R1,078	657	.7	--	--
2003	184	R511	51	247	20	15	36	R1,064	R692	.7	--	--
2004	196	R536	52	267	36	10	34	R1,151	R826	.7	--	--
2005	199	R498	51	266	31	12	34	R1,092	R463	.7	--	--
2006	R190	R521	42	265	35	13	41	R1,108	R398	.6	--	--
2007	180	R526	52	242	33	15	40	R1,089	R398	.6	--	--
2008	152	R484	48	210	37	16	41	R989	R398	.6	--	--
2009	R132	R532	43	185	R30	9	41	R972	R398	.4	--	--
2010	132	R581	48	R196	R10	5	43	R1,015	R398	.6	--	--
2011P	130	575	46	187	11	4	44	996	398	.6	--	--
Quadrillion Btu												
1980	0.96	0.78	0.35	1.43	R0.09	0.19	0.34	R4.14	0.65	0.08	R4.87	R6.2
1985	1.03	R.96	.32	.82	R.10	.16	.24	3.63	.52	.03	4.18	5.5
1990	1.17	R1.33	.36	1.12	.12	.11	.23	R4.44	R.58	.02	R5.05	R6.0
1991	1.08	R1.52	.32	1.15	.11	.09	.26	R4.52	.59	.02	R5.13	R6.1
1992	1.10	R1.61	.33	1.20	.17	.10	.21	R4.73	R.63	.04	R5.40	R6.3
1993	1.15	R1.55	.34	1.22	R.11	.10	.20	R4.68	R.66	.03	R5.37	R6.1
1994	1.17	R1.75	.35	1.26	R.13	.08	.20	4.95	.69	.03	5.67	6.4
1995	1.18	R1.72	.35	1.21	R.12	.07	.20	R4.85	R.71	.03	R5.59	R6.1
1996	1.18	R1.80	.34	1.21	R.12	.07	.20	R4.91	R.74	.03	R5.68	R6.0
1997	1.22	R1.80	.35	1.40	R.09	.07	.20	R5.13	R.76	.03	R5.92	6.3
1998	1.26	1.73	.37	1.40	.15	.11	.23	R5.26	.79	.03	R6.07	R6.4
1999	1.32	R2.04	.37	1.33	.22	.15	.22	R5.64	R.76	.03	R6.43	R6.6
2000	1.28	R1.96	.37	1.35	.10	.10	.22	R5.37	R.73	.03	R6.12	R6.2
2001	1.26	R1.76	.34	1.19	.17	.08	.23	R5.03	R.70	.02	R5.75	R6.0
2002	1.24	R1.87	.33	1.27	.15	.10	.22	R5.19	.68	.02	R5.88	R6.0
2003	1.22	R1.83	.31	1.37	.12	.08	.21	R5.15	R.61	.02	R5.78	R5.9
2004	1.30	R1.92	.31	1.59	.22	.05	.20	R5.59	R.54	.02	R6.16	6.1
2005	1.32	R1.78	.31	1.47	.19	.06	.20	R5.34	R.48	.02	R5.83	5.8
2006	1.26	R1.85	.25	1.48	.21	.07	.24	R5.37	R.41	.02	R5.80	5.8
2007	1.20	R1.86	.31	1.35	.20	.08	.24	R5.23	R.41	.02	R5.66	R5.6
2008	1.01	R1.70	.29	1.17	.23	.08	.24	R4.73	R.41	.02	R5.16	R5.2
2009	.87	R1.85	.26	1.03	.18	.05	.24	R4.48	R.41	.01	4.91	5.2
2010	.88	R2.02	.29	1.09	R.06	.03	.25	R4.62	R.41	.02	R5.05	R5.2
2011P	.86	1.98	.28	1.04	.06	.02	.26	4.50	.41	.02	4.93	5.1

U.S. Energy Information Administration (2012) *Annual Energy Review 2011*, Table 1.15.

Table 3-20: Adjusted Consumption of Fossil Fuels for Non-Energy Uses (TBtu)

Year	1990	2000	2005	2006	2007	2008	2009	2010
Industry	**4,138.4**	**5,192.2**	**5,124.0**	**4,945.4**	**4,826.0**	**4,483.0**	**4,118.8**	**4,217.7**
Industrial Coking Coal	+	53.6	80.5	62.9	2.3	29.1	6.4	64.9
Industrial Other Coal	8.2	12.4	11.9	11.9	11.9	11.9	11.9	11.9
Natural Gas to Chemical Plants	263.2	418.6	389.4	228.0	222.4	227.0	219.5	221.9
Asphalt & Road Oil	1,170.2	1,275.7	1,323.2	1,261.2	1,197.0	1,012.0	873.1	877.8
LPG	1,118.7	1,606.9	1,443.9	1,489.8	1,479.4	1,416.9	1,467.2	1,545.8
Lubricants	186.3	189.9	160.2	156.1	161.2	149.6	134.5	149.5
Pentanes Plus	77.5	229.3	146.3	105.4	132.4	114.7	93.2	103.6
Naphtha (<401 ° F)	325.8	593.7	679.6	617.5	541.4	466.7	449.7	471.3
Other Oil (>401 ° F)	661.2	533.8	499.5	572.7	667.7	598.5	391.7	403.7
Still Gas	21.3	12.6	67.7	57.2	44.2	47.3	133.9	147.2
Petroleum Coke	27.2	7.5	105.2	134.2	117.8	147.4	112.1	3.0
Special Naphtha	100.7	94.4	60.9	68.9	75.3	83.1	44.1	25.5
Distillate Fuel Oil	7.0	11.7	11.7	17.5	17.5	17.5	17.5	17.5
Waxes	33.3	33.1	31.4	26.1	21.9	19.1	12.2	15.4
Miscellaneous Products	137.8	119.2	112.8	136.0	133.5	142.0	151.8	158.8
Transportation	**176.0**	**179.4**	**151.3**	**147.4**	**152.2**	**141.3**	**127.1**	**141.2**
Lubricants	176.0	179.4	151.3	147.4	152.2	141.3	127.1	141.2
U.S. Territories	**86.7**	**152.2**	**121.9**	**133.4**	**108.4**	**126.7**	**56.3**	**56.3**
Lubricants	0.7	3.1	4.6	6.2	5.9	2.7	1.0	1.0
Other Petroleum (Misc. Prod.)	86.0	149.1	117.3	127.2	102.5	124.1	55.2	55.2
Total	**4,401.1**	**5,523.7**	**5,397.2**	**5,226.2**	**5,086.6**	**4,751.0**	**4,302.1**	**4,415.2**

+ Does not exceed 0.05 TBtu

Note: To avoid double-counting, coal coke, petroleum coke, natural gas consumption, and other oils are adjusted for industrial process consumption reported in the Industrial Processes sector. Natural gas, LPG, Pentanes Plus, Naphthas, Special Naphtha, and Other Oils are adjusted to account for exports of chemical intermediates derived from these fuels. For residual oil (not shown in the table), all non-energy use is assumed to be consumed in C black production, which is also reported in the Industrial Processes chapter.

U.S. EPA (2012) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2010, (Draft),
3.2. Carbon Emitted from Non-Energy Uses of Fossil Fuels (IPCC Source 48 Category 1A),
Table 3-20: Adjusted Consumption of Fossil Fuels for Non-Energy Uses (TBtu)

Table 3-21: 2010 Adjusted Non-Energy Use Fossil Fuel Consumption, Storage, and Emissions

Sector/Fuel Type	Adjusted Non-Energy Use[a] (TBtu)	Carbon Content Coefficient (Tg C/QBtu)	Potential Carbon (Tg C)	Storage Factor	Carbon Stored (Tg C)	Carbon Emissions (Tg C)	Carbon Emissions (Tg CO_2 Eq.)
Industry	**4,217.7**	-	**78.5**	-	**49.6**	**28.9**	**106.1**
Industrial Coking Coal	64.9	25.61	1.7	0.10	0.2	1.5	5.5
Industrial Other Coal	11.9	25.82	0.3	0.59	0.2	0.1	0.5
Natural Gas to Chemical Plants	221.9	14.47	3.2	0.59	1.9	1.3	4.8
Asphalt & Road Oil	877.8	20.55	18.0	1.00	18.0	0.1	0.3
LPG	1,545.8	17.06	26.4	0.59	15.7	10.7	39.3
Lubricants	149.5	20.20	3.0	0.09	0.3	2.7	10.1
Pentanes Plus	103.6	19.10	2.0	0.59	1.2	0.8	2.9
Naphtha (<401° F)	471.3	18.55	8.7	0.59	5.2	3.5	13.0
Other Oil (>401° F)	403.7	20.17	8.1	0.59	4.8	3.3	12.1
Still Gas	147.2	17.51	2.6	0.59	1.5	1.0	3.8
Petroleum Coke	3.0	27.85	0.1	0.30	+	0.1	0.2
Special Naphtha	25.5	19.74	0.5	0.59	0.3	0.2	0.7
Distillate Fuel Oil	17.5	20.17	0.4	0.50	0.2	0.2	0.6
Waxes	15.4	19.80	0.3	0.58	0.2	0.1	0.5
Miscellaneous Products	158.8	20.31	3.2	+	+	3.2	11.8
Transportation	**141.2**	-	**2.9**	-	**0.3**	**2.6**	**9.5**
Lubricants	141.2	20.20	2.9	0.09	0.3	2.6	9.5
U.S. Territories	**56.3**	-	**1.1**	-	**0.1**	**1.0**	**3.7**
Lubricants	1.0	20.20	+	0.09	+	+	0.1
Other Petroleum (Misc. Prod.)	55.2	20.00	1.1	0.10	0.1	1.0	3.6
Total	**4,415.2**		**82.5**		**49.9**	**32.6**	**119.4**

+ Does not exceed 0.05 Tg
- Not applicable.
[a] To avoid double counting, net exports have been deducted.
Note: Totals may not sum due to independent rounding.

U.S. EPA (2012) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2010, (Draft),
3.2. Carbon Emitted from Non-Energy Uses of Fossil Fuels (IPCC Source 48 Category 1A),
Table 3-21: 2010 Adjusted Non-Energy Use Fossil Fuel Consumption, Storage, and Emissions

Cell: W12
Comment: Rick Heede:
EPA uses carbon storage factor of 59 percent for the proportion of natural gas used for non-energy uses (vs 58 percent in 2009).
U.S. EPA (2012) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2010, (Draft), Annex 4 IPCC Reference Approach for Estimating CO2 Emissions from Fossil Fuel Combustion, Table A-256: 2010 Non-Energy Carbon Stored in Products.

Cell: E13
Comment: Rick Heede:
Revision, Feb12: CMS applies the 58 percent sequestration rate (EPA, 2011, Annex 4: Table A-252) but uses the extensive data from EIA on non-energy uses of natural gas 1980-2010 (EIA 2011 Annual Energy Review 2010, Table 1.15 for both nitrogenous fertilizer and methanol.
U.S. EPA (2011) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2009, Annex 4 IPCC Reference Approach for Estimating CO2 Emissions from Fossil Fuel Combustion, Table A-252: 2009 Non-Energy Carbon Stored in Products; Table A-253: Sequestered CO2 and Oxidation factors.
Older cell note (retained for background): EIA(2004) Documentation for Emissions of Greenhouse Gases in the United States 2002, p. 29-30: EIA states that the use of natural gas feedstocks to make nitrogenous fertilizers "is considered a non-sequestering use, because the underlying chemical is ammonia (NH3), which is manufactured by steam reforming of natural gas and reacting the synthesis gas with atmospheric nitrogen, literally leaving the carbon in the feedstock `up in the air.'" Other pathways, e.g., recovering the carbon for urea production, only delays the carbon's release to the atmosphere.

Cell: G13
Comment: Rick Heede:
See cell note under "nitrogenous fertilizers."

Cell: J13
Comment: Rick Heede:
EIA (2011) Annual Energy Review 2010, Table 6.1 Natural Gas Overview, 1949-2010.

Cell: T14
Comment: Rick Heede:
One reviewer of our methodology report pointed out that the sequestration rate used by EPA (59 percent) is probably too high, and thus the final sequestration rate of 1.71 percent also high, and leads to underestimating final emissions from natural gas production. CMS contacted Perry Lindstrom (US Energy Information Administration, Office of Energy Analysis) in Sep12. The agency is reviewing natural gas non-energy uses with the US EPA, and while the sequestration rate does appear too high, Mr Lindstrom cannot release any data until the procedure is reviewed by external experts and final changes are approved -- presumably in time for the EPA's completion of its US emission inventory in April 2013.
Fertilizer use of natural gas is now considered non-sequestered. the only natural gas use that is sequestered is methanol for the plastics industry. A revised sequestration rate is thus not available.
This project will retain the use of the existing result of 1.711 percent overall sequestration rate, and note that a downward revision is probable in the future when data becomes available.

Cell: C19
Comment: Rick Heede:
Data from EIA (2011) Annual Energy Review 2010, Table 1.15 Fossil Fuel Consumption for Nonfuel Use, 1980-2010.

Cell: P19
Comment: Rick Heede:
U. S. Energy Information Administration (2011) Annual Energy Review 2010 Table 1.15 Fossil Fuel Consumption for Nonfuel Use Estimates, 1980-2010, www.eia.gov/totalenergy/data/annual
The 2011 AER (Sep12) revises natural gas for non-combustion uses, mostly slightly downward, for many years 1980-2010. CMS has not adjusted the table or the calculations below.
Note: Perry Lindstrom (former inventory manager at US EPA, now EIA) notes that the EPA is analyzing non-energy uses, and emissions and sequestration rates. He noted in a personal communication 27Sep2012 that natural gas non-energy usage rates are probably high and likely to be revised downward, and that net sequestration rates are probably high and likely to be revised downward.** The effect will be to lower sequestration quantities and rates. However, the new data will not be released until ~April 2013. CMS therefore cannot modify the non-energy factors developed and applied in this analysis at this point. Revisions may follow at a later date.
** Natrual gas non-combustion fuel use was revised from 0.64 Q Btu to 0.41 Q Btu.

Cell: Q19
Comment: Rick Heede:
CMS uses the latest EPA data (Nov2011): Climate leaders Emission Factor Hub at www.epa.gov/climateleaders/guidance/ghg-emissions.html

Cell: U19
Comment: Rick Heede:
U. S. Energy Information Administration (2011) Annual Energy Review 2010, page 317: Table 11.2 Carbon Dioxide Emissions From Energy Consumption by Source, Selected Years, 1949-2010 (Million Metric Tons of Carbon Dioxide). Note: "Data are estimates for carbon dioxide emissions from energy consumption, including the nonfuel use of fossil fuels."

Cell: P50
Comment: Rick Heede:
EPA (2011) Annex 4: table A-252 shows 0.366 Q Btu of natural gas for non-energy uses vs EIA's 0.62 Q Btu. Using the EIA data set and the EPA sequestration rate of 58 percent means a higher quantity of stored carbon (19.07 MtCO2 vs EPA's 11.26 MtCO2 in 2009), as well as a higher overall carbon sequestration rate (1.57 percent of all natural gas supplied in the U.S. in 2009, or 1.682 percent if averaged for 1980-2010).

Cell: P51
Comment: Rick Heede:
EPA cites EIA data for 2010 of 221.9 TBtu that differs from final results in EIA's Table 1.15 listed here. EIA and EPA tables are reproduced at right.