Summary of emissions from oil, natural gas, coal, cement production, and flaring

Richard Heede
Climate Accountability Institute
16-Oct-20

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	1751-1789	1790s										1800s					
	Sum 1751-1789	1790	1791	1792	1793	1794	1795	1796	1797	1798	1799	1800	1801	1802	1803	1804	1805

Oil & NGL

Annual and cumulative Carbon Majors (MtCO2)																	
Annual and cumulative Carbon Majors (MtC)																	
Annual and cumulative global oil emissions (MtCO2)																	
Annual and cumulative global oil emissions (MtC)	none																
Percent of annual CDIAC oil emissions identified																	
Global cumulative to date oil emissions (MtCO2)																	
Global cumulative to date oil emissions (percent)																	

Natural Gas

Annual and cumulative Carbon Majors (MtCO2)																	
Annual and cumulative Carbon Majors (MtC)																	
Annual and cumulative global nat gas emissions (MtCO2)																	
Annual and cumulative global nat gas emissions (MtC)	none																
Percent of annual CDIAC gas emissions identified																	
Global cumulative to date nat gas emissions (MtCO2)																	
Global cumulative to date nat gas emissions (percent)																	

Coal

Annual and cumulative Carbon Majors (MtCO2)																	
Annual and cumulative Carbon Majors (MtC)																	
Annual and cumulative global coal emissions (MtCO2)	531 sum 1751-1789	18	22	22	22	22	22	22	26	26	26	29	29	37	33	33	33
Annual and cumulative global coal emissions (MtC)	145 sum 1751-1849	5	6	6	6	6	6	6	7	7	7	8	8	10	9	9	9
Percent Carbon Majors of global coal emissions	1,254																
Global cumulative to date coal emissions (MtCO2)		150	156	162	168	174	180	186	193	200	207	215	223	233	242	251	260
Global cumulative to date coal emissions (percent)		0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Cement

Annual and cumulative Carbon Majors (MtCO2)																	
Annual and cumulative Carbon Majors (MtC)																	
Annual and cumulative global cement emissions (MtCO2)																	
Annual and cumulative global cement emissions (MtC)	none																
Percent Carbon Majors of global cement emissions																	

Flaring

Annual and cumulative Carbon Majors (MtCO2)																	
Annual and cumulative Carbon Majors (MtC)																	
Annual and cumulative global flaring (MtCO2)																	
Annual and cumulative global flaring (MtC)	CDIAC estimates flaring emissions from 1950 to 2010																
Percent Carbon Majors of global flaring emissions																	

Total

	4,594.90																
Annual and cumulative Carbon Majors (MtCO2)	Global CO2 1751-1849																
Annual and cumulative Carbon Majors (MtC)	4,595																
Annual and cumulative global 1751- (MtCO2)	531 Global CO2 1751-1789	18	22	22	22	22	22	22	26	26	26	29	29	37	33	33	33
Annual and cumulative global 1751- (MtC)	145 Global CO2 1751-1849	5	6	6	6	6	6	6	7	7	7	8	8	10	9	9	9
Percent Carbon Majors of global CO2 1751-	1,254 MtC																

Cumulative

Annual Carbon Majors 1854-																	
Total Carbon Majors 1854-																	
Percent Carbon Majors of global CO2 1751-																	
Annual global CO2 1751-	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0
Cumulative global CO2 1751-	145	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
Percent Carbon Majors of global CO2 1751-		0.03%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.05%	0.05%	0.05%	0.05%	0.05%	0.05%	0.06%	0.06%
	Sum 1751-1769	1790	1791	1792	1793	1794	1795	1796	1797	1798	1799	1800	1801	1802	1803	1804	1805

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	1800s				1810s											1820s										1830s					
	1806	1807	1808	1809	1810	1811	1812	1813	1814	1815	1816	1817	1818	1819	1820	1821	1822	1823	1824	1825	1826	1827	1828	1829	1830	1831	1832	1833	1834	1835
47	37	37	37	37	37	40	40	40	40	44	48	51	51	51	51	51	55	59	59	62	62	66	66	66	88	84	84	88	88	92
49	10	10	10	10	10	11	11	11	11	12	13	14	14	14	14	14	15	16	16	17	17	18	18	18	24	23	23	24	24	25
52	270	280	290	300	310	321	332	343	354	366	379	393	407	421	435	449	464	480	496	513	530	548	566	584	608	631	654	678	702	727
53	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%
89	37	37	37	37	37	40	40	40	40	44	48	51	51	51	51	51	55	59	59	62	62	66	66	66	88	84	84	88	88	92
91	10	10	10	10	10	11	11	11	11	12	13	14	14	14	14	14	15	16	16	17	17	18	18	18	24	23	23	24	24	25
105	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.4	2.5	2.6	2.7
107	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
109	0.06%	0.06%	0.07%	0.07%	0.07%	0.07%	0.08%	0.08%	0.08%	0.08%	0.09%	0.09%	0.09%	0.10%	0.10%	0.10%	0.11%	0.11%	0.11%	0.12%	0.12%	0.12%	0.13%	0.13%	0.14%	0.14%	0.15%	0.2%	0.2%	0.2%
111	1806	1807	1808	1809	1810	1811	1812	1813	1814	1815	1816	1817	1818	1819	1820	1821	1822	1823	1824	1825	1826	1827	1828	1829	1830	1831	1832	1833	1834	1835

Sum Oil, Gas, Coal, & Cement

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	1830s				1840s										1850s										1860s					
	1836	1837	1838	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865
43																			0	0	0	0	0	0	0	0	0	0	0	0
45																			0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
47	106	106	110	114	121	125	132	136	143	158	158	169	172	183	198	198	209	216	253	260	278	282	286	304	333	348	352	377	410	436
49	29	29	30	31	33	34	36	37	39	43	43	46	47	50	54	54	57	59	69	71	76	77	78	83	91	95	96	103	112	119
51																			0.04%	0.04%	0.05%	0.06%	0.07%	0.07%	0.07%	0.07%	0.08%	0.08%	0.10%	0.11%
52	756	785	815	846	879	913	949	986	1,025	1,068	1,111	1,157	1,204	1,254	1,308	1,362	1,419	1,478	1,547	1,618	1,694	1,771	1,849	1,932	2,023	2,118	2,214	2,317	2,429	2,548
53	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%	0.6%	0.6%	0.7%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	0.9%	0.9%	1.0%	1.0%	1.1%	1.1%	1.2%	1.2%
85																			0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.5
87																			0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
89	106	106	110	114	121	125	132	136	143	158	158	169	172	183	198	198	209	216	253	260	278	282	286	304	333	348	352	377	410	436
91	29	29	30	31	33	34	36	37	39	43	43	46	47	50	54	54	57	59	69	71	76	77	78	83	91	95	96	103	112	119
93																			0.04%	0.04%	0.05%	0.06%	0.07%	0.07%	0.07%	0.07%	0.08%	0.08%	0.10%	0.11%
99																													0.000	0.001
101																													1,120	1,120
103																													0.0%	0.0%
105	2.8	2.9	3.0	3.1	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.7	5.9	6.2	6.5	6.8	7.1	7.4	7.8	8.1	8.5	8.9	9.3
107	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
109	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.6%	0.6%
111	1836	1837	1838	1839	1840	1841	1842	1843	1844	1845	1846	1847	1848	1849	1850	1851	1852	1853	1854	1855	1856	1857	1858	1859	1860	1861	1862	1863	1864	1865

linked to Coal emissions worksheet --->

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	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW	CX	CY	CZ	DA	DB	DC	DD
	1860s				1870s														1880s								1890s	
10	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893
15																			0	0	0	0	0	0	0	1	1	1
17																			0	0	0	0	0	0	0	0	0	0
19					4	4	4	4	4	4	4	7	7	11	11	15	15	11	15	15	18	18	18	22	29	33	33	37
21					1	1	1	1	1	1	1	2	2	3	3	4	4	3	4	4	5	5	5	6	8	9	9	10
23																			0%	0%	1%	1%	1%	1%	1%	2%	2%	2%
24					1	2	3	4	5	6	7	9	11	14	17	21	25	28	32	36	41	46	51	57	65	74	83	93
25					0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
33																			4	7	11	18	11	11	7	7	7	7
34																			0									
35																			1	2	3	5	3	3	2	2	2	2
38																			1	3	6	11	14	17	19	21	23	
39																			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
43	1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4	5	5	5	5	5	6	6	6
45	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2
47	447	476	491	520	535	572	634	671	634	685	696	704	711	758	854	876	923	986	993	1,000	1,008	1,052	1,162	1,165	1,264	1,319	1,330	1,312
49	122	130	134	142	146	156	173	183	173	187	190	192	194	207	233	239	252	269	271	273	275	287	317	318	345	360	363	358
51	0.12%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.4%	0.5%	0.4%	0.4%	0.4%	0.5%
52	2,670	2,800	2,934	3,076	3,222	3,378	3,551	3,734	3,907	4,094	4,284	4,476	4,670	4,877	5,110	5,349	5,601	5,870	6,141	6,414	6,689	6,976	7,293	7,611	7,956	8,316	8,679	9,037
53	1.3%	1.3%	1.4%	1.5%	1.6%	1.6%	1.7%	1.8%	1.9%	2.0%	2.1%	2.2%	2.2%	2.3%	2.5%	2.6%	2.7%	2.8%	3.0%	3.1%	3.2%	3.4%	3.5%	3.7%	3.8%	4.0%	4.2%	4.4%
71																			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
73																			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85	0.5	0.6	0.7	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4	5	5	5	6	6	6	7	7
87	0.1	0.2	0.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2
89	447	476	491	520	539	575	638	674	638	689	700	711	718	769	865	890	938	997	1,008	1,019	1,033	1,081	1,198	1,198	1,304	1,359	1,370	1,356
91	122	130	134	142	147	157	174	184	174	188	191	194	196	210	236	243	256	272	275	278	282	295	327	327	356	371	374	370
93	0.12%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%
99	0.001	0.002	0.003	0.004	0.005	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
101	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
103	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
105	9.8	10	11	11	12	12	13	14	14	15	16	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	34
107	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
109	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%	0.8%	0.8%	0.9%	0.9%	1.0%	1.0%	1.1%	1.1%	1.2%	1.2%	1.3%	1.3%	1.4%	1.5%	1.5%	1.6%	1.7%	1.7%	1.8%	1.9%	2.0%	2.1%
111	1866	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890	1891	1892	1893

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	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN	DO	DP	DQ	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA	EB	EC	ED	EE
			1890s						1900s										1910s								
	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
15	1	1	2	3	2	2	2	2	2	3	3	3	5	6	6	6	8	8	14	19	13	13	24	25	21	28	38
17	0	0	0	1	1	0	0	1	1	1	1	1	1	2	2	2	2	2	4	5	4	3	7	7	6	8	10
19	33	40	44	48	48	51	59	66	70	73	84	84	84	103	110	117	125	132	136	150	154	165	176	198	194	224	286
21	9	11	12	13	13	14	16	18	19	20	23	23	23	28	30	32	34	36	37	41	42	45	48	54	53	61	78
23	4%	3%	4%	5%	5%	3%	3%	3%	3%	4%	3%	4%	6%	6%	5%	5%	6%	6%	10%	13%	9%	8%	14%	13%	11%	13%	13%
24	102	113	125	138	151	165	181	199	218	238	261	284	307	335	365	397	431	467	504	545	587	632	680	734	787	848	926
25	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.6%
29						[marker]	0	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3
31						[marker]	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
33	7	7	7	7	7	11	11	15	15	15	15	18	18	18	18	22	26	26	29	29	29	33	37	40	37	37	40
35	2	2	2	2	2	3	3	4	4	4	4	5	5	5	5	5	7	7	8	8	9	10	11	10	10	11	
37					[marker]		4.5%	4.8%	5.4%	6.3%	6.8%	6.8%	8.2%	8.6%	8.5%	8.5%	7.7%	7.7%	7.4%	7.7%	7.8%	7.4%	8.0%	7.6%	7.6%	7.9%	7.8%
38	25	27	29	31	33	36	39	43	47	51	55	60	65	70	75	81	88	95	103	111	119	128	138	149	159	169	180
39	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%
43	6	7	7	7	7	8	43	47	50	53	53	52	52	51	50	51	50	50	49	105	103	102	101	99	98	97	95
45	2	2	2	2	2	2	12	13	14	15	14	14	14	14	14	14	14	14	13	29	28	28	27	27	27	26	26
47	1,363	1,440	1,484	1,557	1,645	1,799	1,887	1,946	1,990	2,173	2,188	2,330	2,492	2,748	2,616	2,737	2,851	2,902	3,056	3,279	2,931	2,873	3,085	3,265	3,199	2,693	3,089
49	372	393	405	425	449	491	515	531	543	593	597	636	680	750	714	747	778	792	834	895	800	784	842	891	873	735	843
51	0.5%	0.5%	0.5%	0.5%	0.4%	0.4%	2.3%	2.4%	2.5%	2.4%	2.4%	2.2%	2.1%	1.9%	1.9%	1.8%	1.8%	1.7%	1.6%	3.2%	3.5%	3.6%	3.3%	3.0%	3.1%	3.6%	3.1%
52	9,409	9,802	10,207	10,632	11,081	11,572	12,087	12,618	13,161	13,754	14,351	14,987	15,667	16,417	17,131	17,878	18,656	19,448	20,282	21,177	21,977	22,761	23,603	24,494	25,367	26,102	26,945
53	4.5%	4.7%	4.9%	5.1%	5.3%	5.6%	5.8%	6.1%	6.3%	6.6%	6.9%	7.2%	7.5%	7.9%	8.3%	8.6%	9.0%	9.4%	9.8%	10.2%	10.6%	11.0%	11.4%	11.8%	12.2%	12.6%	13.0%
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.2	0.4	0.4	0	0	1
73	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
85	8	8	8	10	10	9	46	50	53	57	57	56	58	58	58	59	60	60	65	127	119	117	128	128	122	128	137
87	2	2	2	3	3	3	12	14	15	16	15	15	16	16	16	16	16	16	18	35	33	32	35	35	33	35	37
89	1,403	1,488	1,535	1,612	1,700	1,861	1,957	2,026	2,074	2,261	2,286	2,433	2,594	2,869	2,744	2,876	3,001	3,060	3,221	3,459	3,115	3,071	3,298	3,503	3,430	2,953	3,415
91	383	406	419	440	464	508	534	553	566	617	624	664	708	783	749	785	819	835	879	944	850	838	900	956	936	806	932
93	0.5%	0.5%	0.5%	0.6%	0.6%	0.5%	2.3%	2.4%	2.6%	2.5%	2.5%	2.3%	2.2%	2.0%	2.1%	2.0%	2.0%	2.0%	2.0%	3.7%	3.8%	3.8%	3.9%	3.7%	3.5%	4.3%	4.0%
99	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.4	1.5	1.6	1.8	1.9
101	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
103	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%
105	35	36	38	40	41	43	45	47	49	51	54	56	59	62	64	67	70	73	77	80	83	86	89	93	96	99	103
107	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
109	2.2%	2.3%	2.4%	2.5%	2.6%	2.7%	2.8%	2.9%	3.1%	3.2%	3.3%	3.5%	3.6%	3.8%	4.0%	4.2%	4.4%	4.5%	4.7%	5.0%	5.2%	5.3%	5.5%	5.8%	6.0%	6.2%	6.4%
111	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920

Summary of emissions from oil, natural gas, coal, cement production, and flaring

Richard Heede
Climate Accountability Institute
16-Oct-20

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1928: first year CDIAC cement data

	1920s									1930s										1940s							
	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947
	47	58	85	90	96	124	148	170	186	200	182	187	200	236	261	284	350	374	371	379	402	383	446	537	597	677	744
	13	16	23	25	26	34	40	46	51	55	50	51	55	64	71	78	95	102	101	103	110	105	122	147	163	185	203
	308	344	407	403	425	436	498	524	586	557	539	517	564	594	645	704	802	784	813	839	865	813	876	1,008	1,008	1,070	1,180
	84	94	111	110	116	119	136	143	160	152	147	141	154	162	176	192	219	214	222	229	236	222	239	275	275	292	322
	15%	17%	21%	22%	23%	28%	30%	32%	32%	36%	34%	36%	36%	40%	40%	40%	44%	48%	46%	45%	46%	47%	51%	53%	59%	63%	63%
	1,010	1,104	1,215	1,325	1,441	1,560	1,696	1,839	1,999	2,151	2,298	2,439	2,593	2,755	2,931	3,123	3,342	3,556	3,778	4,007	4,243	4,465	4,704	4,979	5,254	5,546	5,868
	0.7%	0.7%	0.8%	0.9%	0.9%	1.0%	1.1%	1.2%	1.3%	1.4%	1.5%	1.6%	1.7%	1.8%	1.9%	2.0%	2.2%	2.3%	2.4%	2.6%	2.7%	2.9%	3.0%	3.2%	3.4%	3.6%	3.8%
	3	3	4	5	5	10	11	12	14	18	18	19	20	22	25	29	35	31	36	42	47	49	53	58	62	70	79
	1	1	1	1	1	3	3	3	4	5	5	5	6	6	7	8	10	8	10	11	13	13	15	16	17	19	22
	37	40	51	59	62	70	77	84	103	103	92	88	92	103	110	125	139	136	139	154	154	165	183	198	216	224	246
	10	11	14	16	17	19	21	23	28	28	25	24	25	28	30	34	38	37	38	42	42	45	50	54	59	61	67
	7.1%	7.5%	7.7%	7.7%	7.5%	14.6%	14.6%	14.5%	13.9%	17.2%	19.3%	21.6%	22.1%	21.9%	23.0%	23.6%	25.3%	22.8%	25.6%	27.3%	30.4%	29.6%	29.1%	29.5%	28.6%	31.5%	32.2%
	190	201	215	231	248	267	288	311	339	367	392	416	441	469	499	533	571	608	646	688	730	775	825	879	938	999	1,066
	0.3%	0.3%	0.3%	0.4%	0.4%	0.4%	0.5%	0.5%	0.5%	0.6%	0.6%	0.7%	0.7%	0.7%	0.8%	0.8%	0.9%	1.0%	1.0%	1.1%	1.2%	1.2%	1.3%	1.4%	1.5%	1.6%	1.7%
	105	114	124	134	143	153	163	170	177	184	207	252	288	347	342	384	389	466	545	624	688	751	518	505	578	644	1,202
	29	31	34	36	39	42	44	46	48	50	56	69	79	95	93	105	106	127	149	170	188	205	141	138	158	176	328
	2,598	2,712	3,096	3,063	3,085	3,100	3,316	3,261	3,470	3,159	2,781	2,473	2,594	2,840	2,972	3,272	3,448	3,224	3,364	3,726	3,822	3,895	4,001	3,836	3,005	3,206	3,635
	709	740	845	836	842	846	905	890	947	862	759	675	708	775	811	893	941	880	918	1,017	1,043	1,063	1,092	1,047	820	875	992
	4.0%	4.2%	4.0%	4.4%	4.6%	4.9%	4.9%	5.2%	5.1%	5.8%	7.4%	10.2%	11.1%	12.2%	11.5%	11.7%	11.3%	14.5%	16.2%	16.7%	18.0%	19.3%	13.0%	13.2%	19.2%	20.1%	33.1%
	27,654	28,394	29,239	30,075	30,917	31,763	32,668	33,558	34,505	35,367	36,126	36,801	37,509	38,284	39,095	39,988	40,929	41,809	42,727	43,744	44,787	45,850	46,942	47,989	48,809	49,684	50,676
	13.3%	13.7%	14.1%	14.5%	14.9%	15.3%	15.7%	16.2%	16.6%	17.0%	17.4%	17.7%	18.1%	18.4%	18.8%	19.3%	19.7%	20.1%	20.6%	21.1%	21.6%	22.1%	22.6%	23.1%	23.5%	23.9%	24.4%
								0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	1	0	0	0
								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
								37	37	37	29	26	26	29	33	40	40	44	48	40	44	40	37	26	26	37	44
								10	10	10	8	7	7	8	9	11	11	12	13	11	12	11	10	7	7	10	12
	1	1	1	1	2	2	2	3	3	3	3	3	3	4	4	5	6	6	6	6	6	6	7	9	10	11	12
	0.2	0.3	0.4	0.4	0.4	0.5	0.7	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	3	3	3
	155	176	214	230	245	289	325	355	380	404	409	461	512	609	632	703	780	877	958	1,051	1,143	1,190	1,026	1,109	1,246	1,402	2,037
	42	48	58	63	67	79	89	97	104	110	112	126	140	166	172	192	213	239	261	287	312	325	280	303	340	383	556
	2,942	3,096	3,554	3,525	3,573	3,606	3,891	3,906	4,195	3,855	3,441	3,104	3,276	3,565	3,759	4,141	4,430	4,188	4,364	4,760	4,884	4,914	5,097	5,068	4,254	4,536	5,104
	803	845	970	962	975	984	1,062	1,066	1,145	1,052	939	847	894	973	1,026	1,130	1,209	1,143	1,191	1,299	1,333	1,341	1,391	1,383	1,161	1,238	1,393
	5.3%	5.7%	6.0%	6.5%	6.9%	8.0%	8.3%	9.1%	9.1%	10.5%	11.9%	14.9%	15.6%	17.1%	16.8%	17.0%	17.6%	21.0%	22.0%	22.1%	23.4%	24.2%	20.1%	21.9%	29.3%	30.9%	39.9%
	2.0	2.2	2.4	2.7	2.9	3.2	3.5	3.9	4.3	4.7	5.1	5.5	6.0	6.7	7.3	8.0	8.8	9.6	10.6	11.7	12.8	14	15	16	17	19	21
	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
	0.2%	0.2%	0.2%	0.2%	0.3%	0.3%	0.3%	0.3%	0.4%	0.4%	0.5%	0.5%	0.5%	0.6%	0.7%	0.7%	0.8%	0.9%	0.9%	1.0%	1.1%	1.2%	1.3%	1.4%	1.6%	1.7%	1.9%
	106	109	112	116	119	123	127	131	135	139	142	145	149	152	156	160	165	169	173	178	183	188	193	198	202	207	212
	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
	6.6%	6.7%	7.0%	7.2%	7.4%	7.6%	7.9%	8.1%	8.4%	8.6%	8.8%	9.0%	9.2%	9.4%	9.7%	9.9%	10.2%	10.5%	10.7%	11.0%	11.3%	11.6%	12.0%	12.3%	12.5%	12.8%	13.1%
	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947

	FG	FH	FI	FJ	FK	FL	FM	FN	FO	FP	FQ	FR	FS	FT	FU	FV	FW	FX	FY	FZ	GA	GB	GC	GD	GE

Summary of emissions from oil, natural gas, coal, cement production, and flaring

Richard Heede
Climate Accountability Institute
16-Oct-20

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	1950s												1960s										1970s		
	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
15	830	823	986	1,135	1,155	1,226	1,277	1,477	1,650	1,820	1,922	2,117	2,350	2,538	2,806	3,042	3,356	3,648	4,111	4,436	4,839	5,253	5,799	6,391	6,856
17	227	224	269	310	315	335	349	403	450	497	524	578	641	693	766	830	916	995	1,122	1,211	1,321	1,434	1,583	1,744	1,871
19	1,334	1,326	1,550	1,755	1,847	1,953	2,041	2,290	2,488	2,616	2,679	2,908	3,123	3,306	3,554	3,808	4,101	4,410	4,749	5,063	5,513	5,965	6,792	7,186	7,747
21	364	362	423	479	504	533	557	625	679	714	731	794	852	902	970	1,039	1,119	1,203	1,296	1,382	1,505	1,628	1,853	1,961	2,114
23	62%	62%	64%	65%	63%	63%	63%	64%	66%	70%	72%	73%	75%	77%	79%	80%	82%	83%	87%	88%	88%	88%	85%	89%	88%
24	6,232	6,594	7,017	7,496	8,000	8,533	9,090	9,715	10,394	11,108	11,839	12,633	13,485	14,387	15,357	16,396	17,515	18,719	20,015	21,397	22,901	24,529	26,382	28,344	30,458
25	4.0%	4.3%	4.5%	4.9%	5.2%	5.5%	5.9%	6.3%	6.7%	7.2%	7.7%	8.2%	8.7%	9.3%	9.9%	10.6%	11.3%	12.1%	13.0%	13.9%	14.8%	15.9%	17.1%	18.4%	19.7%
29	89	99	127	146	158	174	190	210	257	290	330	388	440	492	553	614	682	752	835	939	1,027	1,132	1,260	1,324	1,405
31	24	27	35	40	43	48	52	57	70	79	90	106	120	134	151	167	186	205	228	256	280	309	344	361	383
33	278	297	355	421	454	480	506	550	590	652	704	759	835	882	968	1,049	1,155	1,233	1,342	1,436	1,562	1,712	1,794	1,936	2,055
35	76	81	97	115	124	131	138	150	161	178	192	207	228	241	264	286	315	337	366	392	426	467	490	528	561
37	32.1%	33.4%	35.8%	34.7%	34.8%	36.3%	37.6%	38.2%	43.5%	44.5%	46.9%	51.2%	52.7%	55.7%	57.1%	58.5%	59.0%	61.0%	62.2%	65.4%	65.7%	66.1%	70.2%	68.4%	68.4%
38	1,142	1,223	1,320	1,435	1,559	1,690	1,828	1,978	2,139	2,317	2,509	2,716	2,944	3,185	3,449	3,735	4,051	4,387	4,754	5,145	5,572	6,039	6,528	7,057	7,618
39	1.8%	1.9%	2.1%	2.3%	2.5%	2.7%	2.9%	3.2%	3.4%	3.7%	4.0%	4.3%	4.7%	5.1%	5.5%	6.0%	6.5%	7.0%	7.6%	8.2%	8.9%	9.6%	10.4%	11.2%	12.1%
43	1,319	1,440	1,582	1,654	1,732	1,979	2,227	2,438	2,686	2,519	3,095	3,248	3,401	3,014	3,104	3,234	3,373	3,587	3,696	3,466	3,664	3,722	4,001	3,992	4,254
45	360	393	432	451	473	540	608	665	733	687	845	886	928	823	847	882	920	979	1,009	946	1,000	1,016	1,092	1,089	1,161
47	3,719	3,518	3,921	4,137	4,100	4,122	4,089	4,426	4,665	4,796	4,895	4,952	5,141	4,926	4,913	5,113	5,207	5,293	5,341	5,257	5,315	5,516	5,695	5,697	5,692
49	1,015	960	1,070	1,129	1,119	1,125	1,116	1,208	1,273	1,309	1,336	1,352	1,403	1,344	1,341	1,396	1,421	1,445	1,458	1,435	1,451	1,505	1,554	1,555	1,553
51	35.5%	40.9%	40.3%	40.0%	42.3%	48.0%	54.5%	55.1%	57.6%	52.5%	63.2%	65.6%	66.2%	61.2%	63.2%	63.2%	64.8%	67.8%	69.2%	65.9%	68.9%	67.5%	70.3%	70.1%	74.7%
52	51,691	52,651	53,721	54,850	55,969	57,094	58,210	59,418	60,691	62,000	63,336	64,688	66,090	67,435	68,776	70,171	71,592	73,037	74,494	75,929	77,380	78,885	80,439	81,994	83,547
53	24.9%	25.4%	25.9%	26.4%	27.0%	27.5%	28.0%	28.6%	29.2%	29.9%	30.5%	31.2%	31.8%	32.5%	33.1%	33.8%	34.5%	35.2%	35.9%	36.6%	37.3%	38.0%	38.7%	39.5%	40.2%
57	0	0	0	1	1	2	2	2	3	3	5	6	7	4	4	5	5	5	5	4	4	5	5	11	11
59	0	0	0	0	0	1	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	3	3
61	51	59	66	73	81	88	99	110	117	125	132	146	157	165	178	187	206	215	230	238	255	268	282	300	317
63	14	16	18	20	22	24	27	30	32	34	36	40	43	45	48	51	56	59	63	65	70	73	77	82	87
71	13	13	16	18	19	20	21	24	27	30	31	34	38	41	46	50	55	59	67	72	79	86	95	104	112
73	4	4	4	5	5	5	6	7	7	8	9	9	10	11	12	14	15	16	18	20	22	23	26	28	30
75	■	■	84	88	95	99	99	114	117	128	128	92	89	86	86	91	113	130	145	191	204	244	278	321	347
77	■	■	23	24	26	27	27	31	32	35	35	25	24	24	23	25	31	36	39	52	56	67	76	88	95
79	■	■	18.9%	20.9%	19.6%	20.1%	20.9%	21.1%	22.8%	23.0%	24.3%	37.6%	42.9%	47.9%	53.2%	54.8%	48.5%	45.6%	46.3%	37.9%	38.7%	35.1%	34.1%	32.4%	32.2%
85	2,252	2,375	2,711	2,954	3,066	3,401	3,717	4,152	4,622	4,662	5,382	5,794	6,236	6,090	6,512	6,944	7,470	8,051	8,714	8,918	9,613	10,198	11,159	11,823	12,638
87	614	648	740	806	837	928	1,014	1,133	1,261	1,272	1,469	1,581	1,702	1,662	1,777	1,895	2,039	2,197	2,378	2,434	2,624	2,783	3,046	3,227	3,449
89	5,383	5,199	5,976	6,475	6,577	6,742	6,834	7,490	7,977	8,318	8,538	8,857	9,345	9,366	9,699	10,248	10,781	11,282	11,807	12,184	12,849	13,705	14,840	15,440	16,158
91	1,469	1,419	1,631	1,767	1,795	1,840	1,865	2,044	2,177	2,270	2,330	2,417	2,550	2,556	2,647	2,797	2,942	3,079	3,222	3,325	3,507	3,740	4,050	4,214	4,410
93	41.8%	45.7%	45.4%	45.6%	46.6%	50.4%	54.4%	55.4%	57.9%	56.1%	63.0%	65.4%	66.7%	65.0%	67.1%	67.8%	69.3%	71.4%	73.8%	73.2%	74.8%	74.4%	75.2%	76.6%	78.2%
99	23	25	28	31	34	38	41	45	50	55	60	66	72	78	85	92	99	107	116	125	134	145	156	168	180
101	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
103	2.1%	2.3%	2.5%	2.8%	3.1%	3.4%	3.7%	4.1%	4.5%	4.9%	5.4%	5.9%	6.4%	7.0%	7.6%	8.2%	8.9%	9.6%	10.4%	11.1%	12.0%	12.9%	13.9%	15.0%	16.1%
105	217	222	228	235	241	248	255	262	270	279	287	296	306	315	325	335	346	357	369	381	394	407	422	438	454
107	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
109	13.5%	13.8%	14.2%	14.6%	15.0%	15.4%	15.8%	16.3%	16.8%	17.3%	17.8%	18.4%	18.9%	19.5%	20.1%	20.8%	21.4%	22.1%	22.9%	23.6%	24.4%	25.3%	26.2%	27.1%	28.1%
111	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972

Sum Oil, Gas, Coal, & Cement

Summary of emissions from oil, natural gas, coal, cement production, and flaring

Richard Heede
Climate Accountability Institute
16-Oct-20

■ dataset marker

	1970s							1980s										1990s						1990s		
	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998

[SumOil.xls]Oil Emissions'!DW122

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	7,441	7,777	6,874	7,930	8,154	8,115	8,272	7,743	7,060	6,419	6,163	6,038	5,937	6,328	6,459	6,887	7,426	7,850	7,888	6,522	6,657	6,985	7,135	7,430	7,682	7,939
	2,031	2,122	1,876	2,164	2,225	2,215	2,257	2,113	1,927	1,752	1,682	1,648	1,620	1,727	1,763	1,879	2,027	2,142	2,153	1,780	1,817	1,906	1,947	2,028	2,097	2,167
	8,288	8,168	8,062	8,481	8,792	9,113	9,254	8,921	8,485	8,280	8,212	8,251	8,268	8,515	8,617	8,920	9,070	9,202	9,659	9,142	9,174	9,210	9,309	9,622	9,759	9,854
	2,262	2,229	2,200	2,314	2,399	2,487	2,526	2,435	2,316	2,260	2,241	2,252	2,257	2,324	2,352	2,434	2,475	2,511	2,636	2,495	2,504	2,514	2,541	2,626	2,663	2,689
	90%	95%	85%	94%	93%	89%	89%	87%	83%	78%	75%	73%	72%	74%	75%	77%	82%	85%	82%	71%	73%	76%	77%	77%	79%	81%
	32,720	34,949	37,149	39,463	41,863	44,350	46,875	49,310	51,626	53,885	56,126	58,378	60,635	62,959	65,311	67,745	70,220	72,731	75,367	77,862	80,366	82,880	85,420	88,046	90,710	93,399
	21.2%	22.6%	24.1%	25.6%	27.1%	28.7%	30.3%	31.9%	33.4%	34.9%	36.3%	37.8%	39.3%	40.8%	42.3%	43.9%	45.5%	47.1%	48.8%	50.4%	52.0%	53.7%	55.3%	57.0%	58.7%	60.5%

[SumGas.xls]Gas Emissions'!DP125

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	1,480	1,547	1,572	1,653	1,709	1,773	1,852	1,842	1,880	1,897	1,991	2,191	2,357	2,444	2,635	2,797	2,698	2,740	2,769	2,790	2,810	2,891	2,918	3,056	3,154	3,210
	404	422	429	451	466	484	505	503	513	518	543	598	643	667	719	763	736	748	756	761	767	789	796	834	861	876
	2,136	2,181	2,194	2,324	2,367	2,491	2,631	2,709	2,740	2,681	2,726	2,943	3,065	3,006	3,255	3,414	3,592	3,861	3,939	3,966	4,075	4,114	4,221	4,407	4,429	4,499
	583	595	599	634	646	680	718	739	748	732	744	803	836	820	888	932	980	1,054	1,075	1,082	1,112	1,123	1,152	1,203	1,209	1,228
	69.3%	70.9%	71.6%	71.1%	72.2%	71.2%	70.4%	68.0%	68.6%	70.7%	73.0%	74.5%	76.9%	81.3%	80.9%	81.9%	75.1%	71.0%	70.3%	70.3%	69.0%	70.3%	69.1%	69.3%	71.2%	71.4%
	8,201	8,796	9,395	10,029	10,675	11,355	12,073	12,812	13,560	14,291	15,035	15,839	16,675	17,495	18,384	19,316	20,296	21,350	22,425	23,507	24,619	25,742	26,894	28,097	29,305	30,533
	13.1%	14.0%	15.0%	16.0%	17.0%	18.1%	19.2%	20.4%	21.6%	22.8%	23.9%	25.2%	26.6%	27.9%	29.3%	30.8%	32.3%	34.0%	35.7%	37.4%	39.2%	41.0%	42.8%	44.8%	46.7%	48.6%

[SumCoal.xls]Coal Emissions'!FA94

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	4,394	4,500	4,669	4,763	4,853	5,023	5,255	5,279	5,248	5,518	5,608	5,814	6,245	6,446	6,664	6,914	7,102	7,241	6,942	6,868	6,554	6,700	6,941	6,998	6,986	7,108
	1,199	1,228	1,274	1,300	1,325	1,371	1,434	1,441	1,432	1,506	1,531	1,587	1,704	1,759	1,819	1,887	1,938	1,976	1,895	1,874	1,789	1,829	1,894	1,910	1,907	1,940
	5,854	5,866	5,994	6,262	6,395	6,589	6,837	7,040	6,998	7,125	7,339	7,650	8,206	8,300	8,600	8,893	8,919	8,754	8,676	8,455	8,565	8,613	8,865	9,079	9,037	8,802
	1,598	1,601	1,636	1,709	1,745	1,798	1,866	1,921	1,910	1,944	2,003	2,088	2,240	2,265	2,347	2,427	2,434	2,389	2,368	2,307	2,337	2,351	2,419	2,478	2,466	2,402
	75.1%	76.7%	77.9%	76.1%	75.9%	76.2%	76.9%	75.0%	75.0%	77.5%	76.4%	76.0%	76.1%	77.7%	77.5%	77.7%	79.6%	82.7%	80.0%	81.2%	76.5%	77.8%	78.3%	77.1%	77.3%	80.8%
	85,145	86,746	88,382	90,091	91,836	93,634	95,500	97,422	99,331	101,276	103,279	105,367	107,606	109,871	112,218	114,645	117,079	119,468	121,836	124,144	126,481	128,832	131,251	133,729	136,195	138,597
	41.0%	41.8%	42.6%	43.4%	44.2%	45.1%	46.0%	46.9%	47.8%	48.8%	49.7%	50.7%	51.8%	52.9%	54.0%	55.2%	56.4%	57.5%	58.7%	59.8%	60.9%	62.0%	63.2%	64.4%	65.6%	66.7%

'[SumCement.xls]Process emissions'!BQ36

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	12	12	24	35	39	45	50	52	54	59	65	72	81	90	100	115	114	264	287	317	348	376	405	415	426	438
	3	3	7	9	11	12	14	14	15	16	18	20	22	25	27	31	31	72	78	86	95	103	111	113	116	120
	336	337	334	357	373	396	402	405	405	403	413	420	424	442	459	488	500	501	514	536	556	592	626	640	659	656
	92	92	91	97	102	108	110	111	110	110	113	115	116	120	125	133	136	137	140	146	152	162	171	175	180	179
	■		7.3%	9.7%	10.6%	11.5%	12.5%	12.9%	13.4%	14.5%	15.9%	17.0%	19.1%	20.4%	21.7%	23.5%	22.8%	52.8%	55.8%	59.1%	62.6%	63.6%	64.7%	64.9%	64.6%	66.8%

(IH69*HR15/10^3)+(IA69*HR29/10^3)

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	121	127	112	129	133	132	135	127	116	106	102	100	99	105	108	115	123	130	131	109	111	116	119	124	128	132
	33	35	31	35	36	36	37	35	32	29	28	27	27	29	29	31	34	35	36	30	30	32	32	34	35	36
	402	391	336	395	381	390	360	317	237	236	213	187	182	170	164	186	151	229	244	214	210	212	211	215	220	207
	110	107	92	108	104	106	98	86	65	64	58	51	50	46	45	51	41	62	67	58	57	58	58	59	60	57
	30.2%	32.4%	33.4%	32.7%	34.9%	34.0%	37.5%	40.0%	48.8%	44.8%	47.7%	53.5%	54.3%	61.8%	65.8%	61.6%	81.3%	56.7%	53.6%	50.9%	52.9%	54.8%	56.4%	57.7%	58.3%	63.8%

HR57+HR43+HR15+HR29+HR71

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
	13,449	13,963	13,251	14,510	14,888	15,089	15,564	15,042	14,359	13,998	13,930	14,216	14,718	15,413	15,965	16,827	17,463	18,226	18,017	16,606	16,480	17,068	17,518	18,023	18,376	18,827
	3,670	3,811	3,616	3,960	4,063	4,118	4,248	4,105	3,919	3,820	3,802	3,880	4,017	4,206	4,357	4,592	4,766	4,974	4,917	4,532	4,498	4,658	4,781	4,919	5,015	5,138
	17,016	16,943	16,921	17,819	18,308	18,979	19,485	19,392	18,865	18,725	18,903	19,453	20,146	20,433	21,095	21,902	22,233	22,547	23,032	22,313	22,580	22,742	23,232	23,963	24,103	24,018
	4,644	4,624	4,618	4,863	4,996	5,180	5,318	5,292	5,149	5,110	5,159	5,309	5,498	5,576	5,757	5,977	6,067	6,153	6,286	6,089	6,162	6,207	6,340	6,540	6,578	6,555
	79.0%	82.4%	78.3%	81.4%	81.3%	79.5%	79.9%	77.6%	76.1%	74.8%	73.7%	73.1%	73.1%	75.4%	75.7%	76.8%	78.6%	80.8%	78.2%	74.4%	73.0%	75.1%	75.4%	75.2%	76.2%	78.4%

																					CMEs	Global				

HQ99+HR85/1000

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
																					1988-2013		466	564	82.6%	
	194	208	221	235	250	265	281	296	310	324	338	353	367	383	399	415	433	451	469	486	502	519	537	555	573	592
	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120
	17.3%	18.5%	19.7%	21.0%	22.4%	23.7%	25.1%	26.4%	27.7%	29.0%	30.2%	31.5%	32.8%	34.2%	35.6%	37.1%	38.7%	40.3%	41.9%	43.4%	44.9%	46.4%	47.9%	49.6%	51.2%	52.9%
	471	488	505	523	541	560	579	599	618	636	655	675	695	715	736	758	780	803	826	848	871	894	917	941	965	989
	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613
	29.2%	30.2%	31.3%	32.4%	33.5%	34.7%	35.9%	37.1%	38.3%	39.5%	40.6%	41.8%	43.08%	44.35%	45.66%	47.01%	48.4%	49.79%	51.22%	52.6%	54.0%	55.4%	56.9%	58.3%	59.8%	61.3%

Half of cumulative CO2: 31Dec1990 is 49.79% of cumulative, then 50% is 0.21% greater, which is the ra...

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998

Sum Oil, Gas, Coal, & Cement

Summary of emissions from oil, natural gas, coal, cement production, and flaring

Richard Heede
Climate Accountability Institute
16-Oct-20

dataset marker

Aug19: verify that CME cf GCP is for CO2 only, not CO2e for CMEs vs CO2 GCP

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	2000s											2010s											Sum 1751 to 2018	
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Million tonnes CO2 & C	

Oil & NGL

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Sum	Label
8,000	8,238	8,236	8,000	8,473	8,833	9,205	8,964	9,016	9,124	8,935	9,019	8,931	9,171	9,171	9,346	9,781	9,912	9,682	9,699	446,764	Annual and cumulative Carbon Majors (MtCO2)
2,183	2,248	2,248	2,183	2,312	2,411	2,512	2,446	2,461	2,490	2,438	2,462	2,437	2,503	2,503	2,551	2,669	2,705	2,642	2,647	121,927	Annual and cumulative Carbon Majors (MtC)
10,073	10,256	10,339	10,301	10,545	10,901	10,991	11,072	11,111	11,141	10,963	11,236	11,245	11,447	11,589	11,739	11,943	12,124	12,275	12,426	565,950	Annual and cumulative global oil emissions (MtCO2)
2,749	2,799	2,822	2,811	2,878	2,975	3,000	3,022	3,032	3,041	2,992	3,067	3,069	3,124	3,163	3,204	3,259	3,309	3,350	3,391	154,454	Annual and cumulative global oil emissions (MtC)
79%	80%	80%	78%	80%	81%	84%	81%	81%	82%	81%	80%	79%	80%	79%	80%	82%	82%	79%	78%	78.9%	Percent of annual CDIAC oil emissions identified
96,148	98,947	101,768	104,580	107,458	110,432	113,432	116,454	119,486	122,526	125,518	128,585	131,654	134,778	137,941	141,145	144,404	147,713	151,063	154,454		Global cumulative to date oil emissions (MtCO2)
62.3%	64.1%	65.9%	67.7%	69.6%	71.5%	73.4%	75.4%	77.4%	79.3%	81.3%	83.3%	85.2%	87.3%	89.3%	91.4%	93.5%	95.6%	97.8%	100.0%		Global cumulative to date oil emissions (percent)

CDIAC summed to 2018; GCP/CDIAC Global Carbon Budget data 1959-2016 (Jun18)

Natural Gas

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Sum	Label
3,362	3,420	3,525	3,687	3,847	3,975	4,161	4,295	4,411	4,564	4,430	4,738	4,755	4,914	4,998	4,900	5,001	4,974	5,231	5,513	164,091	Annual and cumulative Carbon Majors (MtCO2)
918	933	962	1,006	1,050	1,085	1,136	1,172	1,204	1,245	1,209	1,293	1,298	1,341	1,364	1,337	1,365	1,357	1,428	1,505	44,782	Annual and cumulative Carbon Majors (MtC)
4,631	4,747	4,793	4,939	5,107	5,271	5,397	5,536	5,722	5,884	5,755	6,198	6,344	6,467	6,547	6,599	6,748	6,885	7,102	7,486	230,034	Annual and cumulative global nat gas emissions (MtCO2)
1,264	1,295	1,308	1,348	1,394	1,439	1,473	1,511	1,561	1,606	1,571	1,691	1,731	1,765	1,787	1,801	1,842	1,879	1,938	2,043	62,779	Annual and cumulative global nat gas emissions (MtC)
72.6%	72.1%	73.6%	74.7%	75.3%	75.4%	77.1%	77.6%	77.1%	77.6%	77.0%	76.5%	74.9%	76.0%	76.3%	74.3%	74.1%	72.2%	73.7%	73.7%	71.3%	Percent of annual CDIAC gas emissions identified
31,797	33,093	34,401	35,748	37,142	38,581	40,053	41,564	43,126	44,732	46,302	47,994	49,725	51,490	53,276	55,077	56,919	58,798	60,736	62,779		Global cumulative to date nat gas emissions (MtCO2)
50.6%	52.7%	54.8%	56.9%	59.2%	61.5%	63.8%	66.2%	68.7%	71.3%	73.8%	76.4%	79.2%	82.0%	84.9%	87.7%	90.7%	93.7%	96.7%	100.0%		Global cumulative to date nat gas emissions (percent)

Coal

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Sum	Label
7,493	7,696	8,093	8,319	9,136	9,846	10,586	11,256	11,783	12,267	12,729	13,539	14,158	14,798	14,995	14,715	14,339	13,178	13,441	13,932	477,139	Annual and cumulative Carbon Majors (MtCO2)
2,045	2,100	2,209	2,270	2,493	2,687	2,889	3,072	3,216	3,348	3,474	3,695	3,864	4,039	4,092	4,016	3,913	3,596	3,668	3,802	130,217	Annual and cumulative Carbon Majors (MtC)
8,738	9,060	9,108	9,499	10,274	10,947	11,615	12,274	12,864	13,360	13,201	14,005	14,884	15,044	14,932	14,938	14,642	14,442	14,484	14,681	760,840	Annual and cumulative global coal emissions (MtCO2)
2,385	2,473	2,486	2,593	2,804	2,988	3,170	3,350	3,511	3,646	3,603	3,822	4,062	4,106	4,075	4,077	3,996	3,941	3,953	4,007	207,642	Annual and cumulative global oil emissions (MtC)
85.7%	84.9%	88.9%	87.6%	88.9%	89.9%	91.1%	91.7%	91.6%	91.8%	96.4%	96.7%	95.1%	98.4%	100.4%	98.5%	97.9%	91.3%	92.8%	94.9%	62.7%	Percent Carbon Majors of global coal emissions
140,982	143,455	145,940	148,533	151,337	154,324	157,494	160,844	164,355	168,001	171,604	175,426	179,488	183,593	187,669	191,745	195,741	199,682				Global cumulative to date coal emissions (MtCO2)
67.9%	69.1%	70.3%	71.5%	72.9%	74.3%	75.8%	77.5%	79.2%	80.9%	82.6%	84.5%	86.4%	88.4%	90.4%	92.3%	94.3%	96.2%				Global cumulative to date coal emissions (percent)

Cement

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Sum	Label
457	470	504	537	613	678	735	838	914	937	1,034	1,156	1,267	1,325	1,425	1,484	1,375	1,394	1,381	1,418	24,348	Annual and cumulative Carbon Majors (MtCO2)
125	128	138	147	167	185	201	229	249	256	282	315	346	362	389	405	375	381	377	387	6,645	Annual and cumulative Carbon Majors (MtC)
685	716	748	791	851	907	959	1,046	1,122	1,138	1,173	1,249	1,341	1,374	1,424	1,476	1,435	1,465	1,476	1,507	39,922	Annual and cumulative global cement emissions (MtCO2)
187	195	204	216	232	248	262	285	306	310	320	341	366	375	389	403	392	400	403	411	10,895	Annual and cumulative global cement emissions (MtC)
66.7%	65.7%	67.3%	68.0%	72.0%	74.7%	76.7%	80.1%	81.5%	82.4%	88.1%	92.5%	94.5%	96.5%	100.1%	100.5%	95.8%	95.2%	93.6%	94.1%	61.0%	Percent Carbon Majors of global cement emissions

Flaring

Natural gas flaring rate: 1.736 kg CO2 per tCO2   Crude oil flaring rate: 15.94 kg CO2 per tCO2

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Sum	Label
133	137	137	134	142	148	154	150	151	153	150	152	151	155	155	158	165	167	163	164	7,408	Annual and cumulative Carbon Majors (MtCO2)
36	37	38	37	39	40	42	41	41	42	41	41	41	42	42	43	45	45	45	45	2,022	Annual and cumulative Carbon Majors (MtC)
199	246	247	258	258	282	302	303	318	330	323	330	323	328	332	337	339	335	343	343	16,105	Annual and cumulative global flaring (MtCO2)
54	67	67	70	70	77	82	83	87	90	88	90	88	89	91	92	92	91	94	94	4,395	Annual and cumulative global flaring (MtC)
66.9%	55.9%	55.6%	51.9%	54.9%	52.4%	51.1%	49.6%	47.6%	46.4%	46.5%	46.1%	46.7%	47.2%	46.6%	46.8%	48.6%	49.8%	47.6%	47.8%	46.0%	Percent Carbon Majors of global flaring emissions

GCP/CDIAC Global Carbon Budget data 1959-2016 (Jun18)

Total

CDIAC includes vented CO2 in natural gas estimates.   This project estimates vented CO2 from gas operations separately, total: 6,394 MtCO2

Total Including vented CO2: 1,126,144

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Sum	Label
19,445	19,962	20,496	20,678	22,211	23,480	24,841	25,503	26,276	27,046	27,278	28,605	29,261	30,363	30,744	30,602	30,660	29,625	29,898	30,727	1,119,750	Annual and cumulative Carbon Majors (MtCO2)
5,307	5,448	5,594	5,643	6,062	6,408	6,780	6,960	7,171	7,381	7,444	7,807	7,986	8,286	8,390	8,352	8,368	8,085	8,160	8,386	310,188	Annual and cumulative Carbon Majors (MtC)
24,326	25,025	25,235	25,788	27,034	28,308	29,264	30,231	31,135	31,854	31,414	33,018	34,136	34,660	34,825	35,089	35,106	35,251	35,681	36,443	1,612,851	Annual and cumulative global 1751-2018 (MtCO2)
6,639	6,830	6,887	7,038	7,378	7,726	7,986	8,250	8,497	8,693	8,573	9,011	9,316	9,459	9,504	9,576	9,581	9,620	9,738	9,946	440,166	Annual and cumulative global 1751-2018 (MtC)
79.9%	79.8%	81.2%	80.2%	82.2%	82.9%	84.9%	84.4%	84.4%	84.9%	86.8%	86.6%	85.7%	87.6%	88.3%	87.2%	87.3%	84.0%	83.8%	84.3%	69.43%	Percent Carbon Majors of global CO2 1751-2018

all CO2 sums verified and linked to CDIAC 1751-2018
excludes "own fuel use" and "vented CO2" (chiefly gas processing)
1,112,342 vertical check (excluding flaring and venting)

Cumulative — Billion tonnes CO2

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Sum	Label
611	631	652	673	695	718	743	769	795	822	849	878	907	937	968	999	1,029	1,059	1,089	1,120	1,120	Annual Carbon Majors 1854-2018 (GtCO2)
1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	1,120	Total Carbon Majors 1854-2018 (GtCO2)
54.6%	56.4%	58.2%	60.1%	62.1%	64.1%	66.4%	68.6%	71.0%	73.4%	75.8%	78.4%	81.0%	83.7%	86.5%	89.2%	91.9%	94.6%	97.3%	100.0%		Percent Carbon Majors of global CO2 1751-2018
1,013	1,038	1,064	1,089	1,116	1,145	1,174	1,204	1,235	1,267	1,299	1,332	1,366	1,400	1,435	1,470	1,505	1,541	1,576	1,613	1,613	Annual global CO2 1751-2018 (GtCO2)
1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	1,613	Cumulative global CO2 1751-2018 (GtCO2)
62.8%	64.4%	65.9%	67.5%	69.2%	71.0%	72.8%	74.7%	76.6%	78.6%	80.5%	82.6%	84.7%	86.8%	89.0%	91.2%	93.3%	95.5%	97.7%	100.0%	69.4%	Percent Carbon Majors of global CO2 1751-2018

te of 1.43% per year is 0.21/1.43 = 14.7% of a year which is 53.4 days; which is 22Feb1991. Calc as of Jan20.

1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018

734 CDIAC/GCP 1988-2013 (GtCO2)

	Cumulative to 2010	Cumulative to 2015	Cumulative to 2016	Cumulative to 2017	Cumulative to 2018
Oil & NGL					
	371,072	417,471	427,383	437,065	446,764
	101,270	113,933	116,638	119,280	121,927
	471,160	529,124	541,248	553,524	565,950
	128,585	144,404	147,713	151,063	154,454
	78.8%	**78.9%**	**79.0%**	**79.0%**	**78.9%**
Natural Gas					
	123,805	148,373	153,347	158,577	164,091
	33,788	40,493	41,850	43,278	44,782
	175,858	208,562	215,447	222,549	230,034
	47,994	56,919	58,798	60,736	62,779
	70.4%	**71.1%**	**71.2%**	**71.3%**	**71.3%**
Coal					
	363,583	436,587	449,765	463,206	477,139
	99,226	119,150	122,746	126,414	130,217
	642,793	717,233	731,675	746,159	760,840
	175,426	195,741	199,682	203,635	207,642
	56.6%	**60.9%**	**61.5%**	**62.1%**	**62.7%**
Cement					
	13,279	20,155	21,549	22,930	24,348
	3,624	5,501	5,881	6,258	6,645
	28,424	35,474	36,939	38,415	39,922
	7,757	9,681	10,081	10,484	10,895
	46.7%	**56.8%**	**58.3%**	**59.7%**	**61.0%**
Flaring					
	6,131	6,914	7,081	7,244	7,408
	1,673	1,887	1,932	1,977	2,022
	13,426	15,083	15,418	15,762	16,105
	3,664	4,116	4,208	4,302	4,395
	45.7%	**45.8%**	**45.9%**	**46.0%**	**46.0%**
Total					
	877,870	1,029,500	1,059,125	1,089,023	1,119,750
	244,176	285,557	293,642	301,802	310,188
	1,331,660	1,505,476	1,540,727	1,576,408	1,612,851
	363,425	410,862	420,482	430,220	440,166
	65.9%	**68.4%**	**68.7%**	**69.1%**	**69.4%**
	Cumulative to 2010	Cumulative to 2015	Cumulative to 2016	Cumulative to 2017	Cumulative to 2018

Cell: IE19
Comment: Rick Heede:
CDIAC data in million tonnes of carbon converted to CO2, which is 3.664191 times Carbon if carbon and oxygen isotopes are accounted for, per Kevin Baumert May05, then at World resources Institute: CO2 conversion is, precisely: C=12.0107 + O=15.9994 x 2 = 44.0095/12.0107 = 3.664191.

Cell: HY21
Comment: Rick Heede:
January 2020: Linked to data in GCP / CDIAC Global CO2 1751-2018.xls. Note revisions of previous years for China from 1990-, flaring revisions, and cement corrections to 1930 (previously entered). Sums 1751-2018 verified. Linked to CDIAC global 1751-2018.xls (last updated Jan20).

Cell: ID21
Comment: Rick Heede:
Sum for 1751 to 2018 verified with CDIAC / GCP data through 2018.

Cell: IE21
Comment: Rick Heede:
From the associated "Methods" paper: CDIAC's emissions are estimated for each fuel using the following formula: CO2 = (P) (FO) (C).
From crude oil and natural gas liquids production in the global-total accounts2
CO2I = CO2 emissions in 106 metric tons of carbon
PI = annual production or consumption in 106 tons
FOI = 0.918 ± 3%
CI = carbon content in tons C per ton fuel = 0.85 ± 1%
From primary and secondary liquid fuel production and trade in the national accounts when non-energy liquid products are specifically subtracted3
CO2I = CO2 emissions in 106 metric tons of carbon
PI = annual production or consumption in 106 tons
FOI = 0.985 ± 3%
CI = carbon content in tons C per ton fuel = 0.85 + 1% ± 2%.
Boden, T.A., G. Marland, and R.J. Andres. 2009. Global, Regional, and National Fossil-Fuel CO2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001.
Jan10: CMS added CDIAC extrapolations for gas emissions from their dataset "Preliminary 2007-08 Global & National Estimates by Extrapolation" (undated) to the main file cited above.
Also: 1 mole C/liter = 12.011 x 10-3 Gt C/km^3; 1 ppm by volume of atmosphere CO2 = 2.13 Gt C; (Uses atmospheric mass (Ma) = 5.137 x 10^18 kg); 1 mole CO2 = 44.009 g CO2 = 12.011 g C; 1 g C = 0.083 mole CO2 = 3.664 g CO2

Cell: IE33
Comment: Rick Heede:
CDIAC data in million tonnes of carbon converted to CO2, which is 3.664191 times Carbon if carbon and oxygen isotopes are accounted for, per Kevin Baumert May05, then at World resources Institute: CO2 conversion is, precisely: C=12.0107 + O=15.9994 x 2 = 44.0095/12.0107 = 3.664191.

Cell: HY35
Comment: Rick Heede:
January 2020: Linked to data in GCP / CDIAC Global CO2 1751-2018.xls. Note revisions of previous years for China from 1990-, flaring revisions, and cement corrections to 1930 (previously entered). Sums 1751-2018 verified. Linked to CDIAC global 1751-2018.xls (last updated Jan20).

Cell: ID35
Comment: Rick Heede:
Sum for 1751 to 2018 verified with CDIAC / GCP data through 2018.

Cell: IE35
Comment: Rick Heede:
From the associated "Methods" paper: CDIAC's emissions are estimated for each fuel using the following formula: CO2 = (P) (FO) (C).
From primary and secondary gas fuel production and trade:
CO2 = CO2 emissions in 10^6 metric tonnes of carbon;
P = annual production or consumption in thousands of 10^12 joules;
FO = 0.98 ± 1%;
C = carbon content in 10^6 tonnes per thousand 10^12 joules = 0.0137 ± 2%.
Boden, T.A., G. Marland, and R.J. Andres. 2009. Global, Regional, and National Fossil-Fuel CO2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001.
Also: 1 mole C/liter = 12.011 x 10-3 Gt C/km^3; 1 ppm by volume of atmosphere CO2 = 2.13 Gt C; (Uses atmospheric mass (Ma) = 5.137 x 10^18 kg); 1 mole CO2 = 44.009 g CO2 = 12.011 g C; 1 g C = 0.083 mole CO2 = 3.664 g CO2

Cell: IE47
Comment: Rick Heede:
CDIAC data in million tonnes of carbon converted to CO2, which is 3.664191 times Carbon if carbon and oxygen isotopes are accounted for, per Kevin Baumert May05, then at World resources Institute: CO2 conversion is, precisely: C=12.0107 + O=15.9994 x 2 = 44.0095/12.0107 = 3.664191. Also: 1 mole C/liter = 12.011 x 10-3 Gt C/km^3; 1 ppm by volume of atmosphere CO2 = 2.13 Gt C; (Uses atmospheric mass (Ma) = 5.137 x 10^18 kg); 1 mole CO2 = 44.009 g CO2 = 12.011 g C; 1 g C = 0.083 mole CO2 = 3.664 g CO2

Cell: HY49
Comment: Rick Heede:
January 2020: Linked to data in GCP / CDIAC Global CO2 1751-2018.xls. Note revisions of previous years for China from 1990-, flaring revisions, and cement corrections to 1930 (previously entered). Sums 1751-2018 verified. Linked to CDIAC global 1751-2018.xls (last updated Jan20).

Cell: ID49
Comment: Rick Heede:
Sum for 1751 to 2018 verified with CDIAC / GCP data through 2018.

Cell: IE49
Comment: Rick Heede:
From the associated "Methods" paper: CDIAC's emissions are estimated for each fuel using the following formula: CO2 = (P) (FO) (C).
From crude oil and natural gas liquids production in the global-total accounts2
CO2I = CO2 emissions in 106 metric tons of carbon
PI = annual production or consumption in 106 tons
FOI = 0.918 ± 3%
CI = carbon content in tons C per ton fuel = 0.85 ± 1%
From primary and secondary liquid fuel production and trade in the national accounts when non-energy liquid products are specifically subtracted3
CO2I = CO2 emissions in 106 metric tons of carbon
PI = annual production or consumption in 106 tons
FOI = 0.985 ± 3%
CI = carbon content in tons C per ton fuel = 0.85 + 1% ± 2%.
Boden, T.A., G. Marland, and R.J. Andres. 2009. Global, Regional, and National Fossil-Fuel CO2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001.
Jan10: CMS added CDIAC extrapolations for gas emissions from their dataset "Preliminary 2007-08 Global & National Estimates by Extrapolation" (undated) to the main file cited above.
Also: 1 mole C/liter = 12.011 x 10-3 Gt C/km^3; 1 ppm by volume of atmosphere CO2 = 2.13 Gt C; (Uses atmospheric mass (Ma) = 5.137 x 10^18 kg); 1 mole CO2 = 44.009 g CO2 = 12.011 g C; 1 g C = 0.083 mole CO2 = 3.664 g CO2

Cell: IE51
Comment: Rick Heede:
Of CDIAC estimated emissions of carbon dioxide from combustion of coal worldwide 1751-2004, CMS has identified (at this writing, 26Nov06) 47.5 percent from the production of coal by identified producers from 1990 to 2004. Note that CMS has differentiated emissions by rank of coal produced, when company or country production data makes this possible to do.

Cell: HY63
Comment: Rick Heede:
January 2020: Linked to data in GCP / CDIAC Global CO2 1751-2018.xls. Note revisions of previous years for China from 1990-, flaring revisions, and cement corrections to 1930 (previously entered). Sums 1751-2018 verified. Linked to CDIAC global 1751-2018.xls (last updated Jan20).

Cell: ID63
Comment: Rick Heede:
Sum for 1751 to 2018 verified with CDIAC / GCP data through 2018.

Cell: IE63
Comment: Rick Heede:
June 2018: replaced the CDIAC data with revised data set (CDIAC and Global Carbon Project and le Quere et al. 2017) with dsata through 2016.
Sources: Cite as: Boden, T. A., Marland, G., and Andres, R. J.: Global, Regional, and National Fossil-Fuel CO2 Emissions, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A., doi 10.3334/CDIAC/00001_V2017, 2017; available at: http://cdiac.ess-dive.lbl.gov/trends/emis/overview_2014.html
Also see globalcarbonproject.org, 2017 Carbon Budget.

Cell: HI69
Comment: Rick Heede:
CMS reviews numerous estimates of flaring emissions in the oil and gas industries in the worksheets in "AncillaryCH4&CO2.xls".
See "Flaring and Venting" worksheet in the "AncillaryCH4&CO2.xls" workbook for details.

Cell: HP69
Comment: Rick Heede:
Flaring rates are calculated in the worksheet "AncillaryCH4&CO2.xls".
See the "Flaring and Venting" worksheet in the AncillaryCO2CH4.xls workbook.

Cell: IE75
Comment: Rick Heede:
CDIAC data in million tonnes of carbon converted to CO2, which is 3.664191 times Carbon if carbon and oxygen isotopes are accounted for, per Kevin Baumert May05, then at World Resources Institute: CO2 conversion is, precisely: C=12.0107 + O=15.9994 x 2 = 44.0095/12.0107 = 3.664191.

Cell: HY77
Comment: Rick Heede:
January 2020: Linked to data in GCP / CDIAC Global CO2 1751-2018.xls. Note revisions of previous years for China from 1990-, flaring revisions, and cement corrections to 1930 (previously entered). Sums 1751-2018 verified. Linked to CDIAC global 1751-2018.xls (last updated Jan20).

Cell: ID77
Comment: Rick Heede:
Sum for 1751 to 2018 verified with CDIAC / GCP data through 2018.

Cell: IE77
Comment: Rick Heede:
Marland, Gregg, & Ralph Rotty (1984) "Carbon dioxide emissions from fossil fuels: a procedure for estimation and results for 1950-1982," Tellus, vol. 36b:232-261.
Fossil fuel, cement, and flaring emissions are estimated in the dataset available at: http://cdiac.ornl.gov/by_new/bysubjec.html#trace
Boden, T.A., G. Marland, and R.J. Andres. 2011. Global, Regional, and National Fossil-Fuel CO2 Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001.

Cell: IE89
Comment: Rick Heede:
CAI compares entity emissions to the CDIAC / Global Carbon Project (www.globalcarbonproject.org) annual estimate of carbon dioxideee emissions from fossil fuels and cement production. The CAI Carbon Majors methodology is based on the CDIAC methdology; see: Heede, Richard (2019) Carbon Majors: Accounting for carbon and methane emissions 1854-2010 Methods & Results Report, ISBN 978-3-659-57841-0, OmniScriptum, Riga, 148 pp.
Reference of the full global carbon budget 2019: Pierre Friedlingstein, Matthew W. Jones, Michael O'Sullivan, Robbie M. Andrew, Judith Hauck, Glen P. Peters, Wouter Peters, Julia Pongratz, Stephen Sitch, Corinne Le Quéré, Dorothee C. E. Bakker, Josep G. Canadell, Philippe Ciais, Rob Jackson, Peter Anthoni, Leticia Barbero, Ana Bastos, Vladislav Bastrikov, Meike Becker, Laurent Bopp, Erik Buitenhuis, Naveen Chandra, Frédéric Chevallier, Louise P. Chini, Kim I. Currie, Richard A. Feely, Marion Gehlen, Dennis Gilfillan, Thanos Gkritzalis, Daniel S. Goll, Nicolas Gruber, Sören Gutekunst, Ian Harris, Vanessa Haverd, Richard A. Houghton, George Hurtt, Tatiana Ilyina, Atul K. Jain, Emilie Joetzjer, Jed O. Kaplan, Etsushi Kato, Kees Klein Goldewijk, Jan Ivar Korsbakken, Peter Landschützer, Siv K. Lauvset, Nathalie Lefèvre, Andrew Lenton, Sebastian Lienert, Danica Lombardozzi, Gregg Marland, Patrick C. McGuire, Joe R. Melton, Nicolas Metzl, David R. Munro, Julia E. M. S. Nabel, Shin-Ichiro Nakaoka, Craig Neill, Abdirahman M. Omar, Tsuneo Ono, Anna Peregon, Denis Pierrot, Benjamin Poulter, Gregor Rehder, Laure Resplandy, Eddy Robertson, Christian Rödenbeck, Roland Séférian, Jörg Schwinger, Naomi Smith, Pieter P. Tans, Hanqin Tian, Bronte Tilbrook, Francesco N Tubiello, Guido R. van der Werf, Andrew J. Wiltshire, Sönke Zaehle. Global Carbon Budget 2019, Earth Syst. Sci. Data, 2019. https://doi.org/10.5194/essd-11-1783-2019
See also: Gilfillan, D., Marland, G., Boden, T. and Andres, R.: Global, Regional, and National Fossil-Fuel CO2 Emissions, available at: https://energy.appstate.edu/CDIAC, last access: 27 September 2019.

Cell: ID91
Comment: Rick Heede:
Sum for 1751 to 2018 verified with CDIAC / GCP data through 2018.

Cell: IQ94
Comment: Rick Heede:

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