

Summary of CO2 & methane emissions from identified oil & NGL production

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Richard Heede
Climate Mitigation Services
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Crude Oil & Natural Gas Liquids

Production less sequestration		Ancillary emissions from flaring, venting, field use, refining and processing, etc.					Total oil & NGL emissions MtCO2e
This study	Percent of CDIAC	Flaring CO2	Vented CO2	Fugitive methane	Fugitive methane		
MtCO2	Percent	MtCO2	MtCO2	MtCH4	MtCO2e	MtCO2e	
	IPCC values (20Dec12)	15.94	3,833	1,924	40.39		
		kg CO2/tCO2	kg CO2/tCO2	kg CH4/tCO2	kg CO2e/tCO2		
	IPCC values pasted:	15.19	3,651	10,080	212		

Rank

Entity

	y	y	y	y	y	y	y	
1	Abu Dhabi, United Arab Emirates	7,559	1.60%	121	29.0	15	305	8,014
2	Alpha Natural Resources, USA							
3	Anadarko, USA	2,445	0.52%	39	9	5	99	2,592
4	Anglo American, UK							
5	Apache, USA	412	0.09%	7	2	1	17	436
6	Arch Coal Company, USA							
7	Bahrain Petroleum Corporation	323	0.07%	5	1	1	13	342
8	BG Group (British Gas) UK	291	0.06%	5	1	1	12	308
9	BHP Billiton, Australia	1,230	0.26%	20	5	2	50	1,304
10	BP, UK	25,883	5.48%	413	99	50	1,045	27,440
11	British Coal Corporation, UK							
12	Canadian Natural Resources, Canada	477	0.10%	8	2	1	19	506
13	Cemex, Mexico							
14	ChevronTexaco, USA	36,583	7.75%	583	140	70	1,478	38,784
15	China, PR (coal & cement only)							
16	CNOOC, PR China	897	0.19%	14	3	2	36	951
17	Coal India, India							
18	ConocoPhillips, USA	9,271	1.96%	148	36	18	374	9,829
19	CONSOL Energy, USA							
20	Cyprus Amax, USA							
21	Czech Republic							
22	Czechoslovakia							
23	Devon Energy, USA	596	0.13%	10	2	1	24	632
24	Ecopetrol, Colombia	1,449	0.31%	23	6	3	59	1,537
25	Egyptian General Petroleum, Egypt	1,891	0.40%	30	7	4	76	2,005
26	EnCana, Canada	528	0.11%	8	2	1	21	559
27	ENI, Italy	3,236	0.69%	52	12	6	131	3,431
28	ExxonMobil, USA	29,587	6.27%	472	113	57	1,195	31,367
29	FSU (Former Soviet Union)	35,462	7.51%	565	136	68	1,432	37,596
30	Gazprom, Russia	1,707	0.36%	27	7	3	69	1,810
31	HeidelbergCement, Germany							
32	Hess, USA	1,486	0.31%	24	6	3	60	1,575
33	Holcim, Switzerland							
34	Husky, Canada	407	0.09%	6	2	1	16	431
35	Iraq National Oil Company, Iraq	6,567	1.39%	105	25	13	265	6,962
36	Italcementi							
37	Kazakhstan							
38	Kiewit Mining Group, USA							
39	Kuwait Petroleum Corp., Kuwait	9,321	1.97%	149	36	18	377	9,882
40	Lafarge, France							
41	Libya National Oil Corp., Libya	5,780	1.22%	92	22	11	233	6,127
42	Lukoil, Russia	3,352	0.71%	53	13	6	135	3,553
43	Luminant / TXU, USA							
44	Marathon, USA	1,848	0.39%	29	7	4	75	1,959
45	Massey Energy Corporation, US							
46	Murphy Oil, USA	256	0.05%	4	1	0	10	271
47	Murray Coal Corporation, USA							
48	National Iranian Oil Co., Iran	23,448	4.97%	374	90	45	947	24,859
49	Nexen, Canada	468	0.10%	7	2	1	19	496
50	Nigerian National Petroleum, Nigeria	5,580	1.18%	89	21	11	225	5,916
51	North American Coal, US							
52	North Korea							
53	Occidental, USA	2,446	0.52%	39	9	5	99	2,594
54	Oil and Gas Corp., India	2,729	0.58%	44	10	5	110	2,894
55	OMV Group, Austria	186	0.04%	3	1	0	8	197
56	Peabody Energy, USA							
57	Pertamina, Indonesia	4,918	1.04%	78	19	9	199	5,214
58	PetroChina (CNPC), China	8,367	1.77%	133	32	16	338	8,871
59	Petrobras, Brazil	4,784	1.01%	76	18	9	193	5,071
60	Petroleos de Venezuela, Venezuela	12,673	2.68%	202	49	24	512	13,435
61	Pemex, Mexico	14,782	3.13%	236	57	28	597	15,671
62	Petroleum Development Oman, Oman	1,871	0.40%	30	7	4	76	1,983
63	Petronas, Malaysia	2,689	0.57%	43	10	5	109	2,851
64	Poland							
65	Polish Oil & Gas, Poland	320	0.07%	5	1	1	13	339
66	Qatar Petroleum, Qatar	2,015	0.43%	32	8	4	81	2,136
67	Repsol, Spain	1,942	0.41%	31	7	4	78	2,059
68	Rio Tinto, UK							
69	Rosneft, Russian Federation	2,201	0.47%	35	8	4	89	2,334
70	Royal Dutch Shell, The Netherlands & UK	21,157	4.48%	337	81	41	855	22,430
71	Ruhrkohle AG (RAG), Germany							
72	Russian Federation							
73	RWE, Germany							
74	Sasol, South Africa							
75	Saudi Aramco, Saudi Arabia	40,133	8.50%	640	154	77	1,621	42,548
76	Singareni Collieries, India							
77	Sinopec, China	1,269	0.27%	20	5	2	51	1,345
78	Sonangol, Angola	1,669	0.35%	27	6	3	67	1,769
79	Sonatrach, Algeria	4,467	0.95%	71	17	9	180	4,736
80	Statoil, Norway	2,872	0.61%	46	11	6	116	3,044
81	Suncor, Canada	870	0.18%	14	3	2	35	922
82	Syrian Petroleum, Syria	1,144	0.24%	18	4	2	46	1,213
83	Taiheyo, Japan							
84	Talisman, Canada	446	0.09%	7	2	1	18	473
85	Total, France	8,796	1.86%	140	34	17	355	9,326
86	UK Coal, UK							
87	Ukraine							
88	Westmoreland Mining, USA							
89	Xstrata, Switzerland							
90	Yukos, Russia	2,645	0.56%	42	10	5	107	2,804
Total CO2 & methane emissions		365,729	77.48%	5,831	1,402	703	14,773	387,735
		365,729	vertical check	1.59%	0.38%		4.04%	387,735

Oil & NGL CO2	Flaring CO2	Vented CO2
This study, MtCO2: 365,729	This study, MtCO2: 6,040	This study, MtCO2: 4,829
CDIAC emissions, MtCO2: 472,012	CDIAC Flaring CO2: 12,601	CDIAC Vented CO2: na
Percent this study of total CDIAC 1751-2010: 77.5%	Percent of CDIAC: 47.9%	Percent of CDIAC: na

Summary of CO2 & methane emissions from identified natural gas production

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Natural Gas

Production less sequestration		Ancillary emissions from flaring, venting, own use of fuels, and fugitive methane					
This study	Percent of CDIAC	Flaring CO2	Vented CO2	Fugitive methane	Fugitive methane	Own fuel use	Total natural gas emissions
MtCO2	Percent	MtCO2	MtCO2	MtCH4	MtCO2e	MtCO2	MtCO2e
	IPCC values (28Dec12)	1,736	28.53	9,878	207.4	59.24	EPA
		kg CO2/tCO2	kg CO2/tCO2	kg CH4/tCO2	kg CO2e/tCO2	kg CO2e/tCO2	IPCC SAR GWP 21xCO2
	IPCC values pasted:	1.525	25.08	3.708	77.9		

Rank Entity

	y	y	10% of oil flaring	y	y	y	y	y
1 Abu Dhabi, United Arab Emirates	1,278	0.73%	2.2	36.48	12.63	265	76	1,658
2 Alpha Natural Resources, USA								
3 Anadarko, USA	1,475	0.84%	2.6	42.09	14.57	306	87	1,913
4 Anglo American, UK								
5 Apache, USA	397	0.23%	0.7	11.32	3.92	82	23	514
6 Arch Coal Company, USA								
7 Bahrain Petroleum Corporation	454	0.26%	0.8	12.95	4.48	94	27	588
8 BG Group (British Gas) UK	952	0.54%	1.7	27.16	9.40	197	56	1,234
9 BHP Billiton, Australia	380	0.22%	0.7	10.86	3.76	79	23	493
10 BP, UK	5,707	3.24%	9.9	162.83	56.37	1,184	338	7,401
11 British Coal Corporation, UK								
12 Canadian Natural Resources, Canada	348	0.20%	0.6	9.93	3.44	72	21	452
13 Cemex, Mexico								
14 ChevronTexaco, USA	8,465	4.81%	14.7	241.54	83.62	1,756	501	10,979
15 China, PR (coal & cement only)								
16 CNOOC, PR China	133	0.08%	0.2	3.79	1.31	28	8	172
17 Coal India, India								
18 ConocoPhillips, USA	5,426	3.08%	9.4	154.81	53.60	1,126	321	7,037
19 CONSOL Energy, USA	36	0.02%	0.1	1.03	0.36	8	2	47
20 Cyprus Amax, USA								
21 Czech Republic								
22 Czechoslovakia								
23 Devon Energy, USA	816	0.46%	1.4	23.28	8.06	169	48	1,058
24 Ecopetrol, Colombia	210	0.12%	0.4	5.99	2.08	44	12	272
25 Egyptian General Petroleum, Egypt	589	0.33%	1.0	16.80	5.82	122	35	764
26 EnCana, Canada	876	0.50%	1.5	24.98	8.65	182	52	1,136
27 ENI, Italy	1,960	1.11%	3.4	55.92	19.36	407	116	2,542
28 ExxonMobil, USA	10,699	6.08%	18.6	305.28	105.69	2,219	634	13,876
29 FSU (Former Soviet Union)	17,937	10.19%	31.1	511.80	177.18	3,721	1,063	23,263
30 Gazprom, Russia	23,383	13.28%	40.6	667.20	230.98	4,851	1,385	30,327
31 HeidelbergCement, Germany								
32 Hess, USA	608	0.35%	1.1	17.35	6.01	126	36	789
33 Holcim, Switzerland								
34 Husky, Canada	180	0.10%	0.3	5.14	1.78	37	11	234
35 Iraq National Oil Company, Iraq	135	0.08%	0.2	3.85	1.33	28	8	175
36 Italcementi								
37 Kazakhstan								
38 Kiewit Mining Group, USA								
39 Kuwait Petroleum Corp., Kuwait	479	0.27%	0.8	13.67	4.73	99	28	621
40 Lafarge, France								
41 Libya National Oil Corp., Libya	436	0.25%	0.8	12.44	4.31	90	26	566
42 Lukoil, Russia	246	0.14%	0.4	7.03	2.43	51	15	320
43 Luminant / TXU, USA								
44 Marathon, USA	791	0.45%	1.4	22.57	7.81	164	47	1,026
45 Massey Energy Corporation, US	113	0.06%	0.2	3.24	1.12	24	7	147
46 Murphy Oil, USA								
47 Murray Coal Corporation, USA								
48 National Iranian Oil Co., Iran	3,258	1.85%	5.7	92.95	32.18	676	193	4,225
49 Nexen, Canada	119	0.07%	0.2	3.39	1.17	25	7	154
50 Nigerian National Petroleum, Nigeria	482	0.27%	0.8	13.74	4.76	100	29	625
51 North American Coal, US								
52 North Korea								
53 Occidental, USA	462	0.26%	0.8	13.17	4.56	96	27	599
54 Oil and Gas Corp., India	978	0.56%	1.7	27.92	9.67	203	58	1,269
55 OMV Group, Austria	115	0.07%	0.2	3.27	1.13	24	7	149
56 Peabody Energy, USA								
57 Pertamina, Indonesia	1,246	0.71%	2.2	35.55	12.31	258	74	1,616
58 PetroChina (CNPC), China	1,306	0.74%	2.3	37.25	12.90	271	77	1,653
59 Petrobras, Brazil	709	0.40%	1.2	20.24	7.01	147	42	920
60 Petroleos de Venezuela, Venezuela	2,099	1.19%	3.6	59.89	20.73	435	124	2,722
61 Pemex, Mexico	3,357	1.91%	5.8	95.79	33.16	696	199	4,354
62 Petroleum Development Oman, Oman	524	0.30%	0.9	14.95	5.18	109	31	680
63 Petronas, Malaysia	1,869	1.06%	3.2	53.32	18.46	388	111	2,424
64 Poland								
65 Polish Oil & Gas, Poland	103	0.06%	0.2	2.95	1.02	21	6	134
66 Qatar Petroleum, Qatar	982	0.56%	1.7	28.02	9.70	204	58	1,274
67 Repsol, Spain	1,019	0.58%	1.8	29.08	10.07	211	60	1,322
68 Rio Tinto, UK								
69 Rosneft, Russian Federation	300	0.17%	0.5	8.56	2.96	62	18	389
70 Royal Dutch Shell, The Netherlands & UK	6,416	3.64%	11.1	183.06	63.38	1,331	380	8,321
71 Ruhrkohle AG (RAG), Germany								
72 Russian Federation								
73 RWE, Germany								
74 Sasol, South Africa								
75 Saudi Aramco, Saudi Arabia	2,687	1.53%	4.7	76.67	26.54	557	159	3,485
76 Singareni Collieries, India								
77 Sinopec, China	144	0.08%	0.2	4.10	1.42	30	9	186
78 Sonangol, Angola	19	0.01%	0.0	0.53	0.18	4	1	24
79 Sonatrach, Algeria	3,491	1.98%	6.1	99.60	34.48	724	207	4,527
80 Statoil, Norway	1,019	0.58%	1.8	29.09	10.07	211	60	1,322
81 Suncor, Canada	373	0.21%	0.6	10.65	3.69	77	22	484
82 Syrian Petroleum, Syria	146	0.08%	0.3	4.16	1.44	30	9	189
83 Taiheyo, Japan								
84 Talisman, Canada	349	0.20%	0.6	9.95	3.44	72	21	452
85 Total, France	1,994	1.13%	3.5	56.88	19.69	414	118	2,586
86 UK Coal, UK								
87 Ukraine								
88 Westmoreland Mining, USA								
89 Xstrata, Switzerland								
90 Yukos, Russia	41	0.02%	0.1	1.18	0.41	9	2	54

Total CO2 & methane emissions	120,113	68.22%	208	3,427	1,187	24,917	7,115	155,781
	120,113	vertical check	0.17%	2.85%		20.74%		155,781

This study, MtCO2	120,113	This study, MtCO2	Total Methane	67,616	This study, MtCO2e
CDIAC emissions, MtCO2	176,055	CDIAC gas CO2	114,645.99	CDIAC CH4, MtCO2e	
Percent this study of total CDIAC 1751-2010	68.2%	Percent of CDIAC	58.98%	Percent of CDIAC	

Summary of CO2 & methane emissions from identified coal and cement production

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Coal				
Coal CO2 emissions		Fugitive methane emissions		
This study	Percent of CDIAC	Fugitive methane	Fugitive methane	Total coal emissions
MtCO2	Percent	MtCH4	MtCO2e	MtCO2e
	IPCC values (22Dec12)	4,035	84.73	
		kg CH4/tCO2	kg CO2e/tCO2	
		IPCC values pasted: 4,035	84.73	IPCC SAR GWP 21xCO2

Cement production	
Calculating emissions	
Cement	Percent of CDIAC
MtCO2	Percent

Rank

Entity

1	Abu Dhabi, United Arab Emirates
2	Alpha Natural Resources, USA
3	Anadarko, USA
4	Anglo American, UK
5	Apache, USA
6	Arch Coal Company, USA
7	Bahrain Petroleum Corporation
8	BG Group (British Gas) UK
9	BHP Billiton, Australia
10	BP, UK
11	British Coal Corporation, UK
12	Canadian Natural Resources, Canada
13	Cemex, Mexico
14	ChevronTexaco, USA
15	China, PR (coal & cement only)
16	CNOOC, PR China
17	Coal India, India
18	ConocoPhillips, USA
19	CONSOL Energy, USA
20	Cyprus Amax, USA
21	Czech Republic
22	Czechoslovakia
23	Devon Energy, USA
24	Ecopetrol, Colombia
25	Egyptian General Petroleum, Egypt
26	EnCana, Canada
27	ENI, Italy
28	ExxonMobil, USA
29	FSU (Former Soviet Union)
30	Gazprom, Russia
31	HeidelbergCement, Germany
32	Hess, USA
33	Holcim, Switzerland
34	Husky, Canada
35	Iraq National Oil Company, Iraq
36	Italcementi
37	Kazakhstan
38	Kiewit Mining Group, USA
39	Kuwait Petroleum Corp., Kuwait
40	Lafarge, France
41	Libya National Oil Corp., Libya
42	Lukoil, Russia
43	Luminant / TXU, USA
44	Marathon, USA
45	Massey Energy Corporation, US
46	Murphy Oil, USA
47	Murray Coal Corporation, USA
48	National Iranian Oil Co., Iran
49	Nexen, Canada
50	Nigerian National Petroleum, Nigeria
51	North American Coal, US
52	North Korea
53	Occidental, USA
54	Oil and Gas Corp., India
55	OMV Group, Austria
56	Peabody Energy, USA
57	Pertamina, Indonesia
58	PetroChina (CNPC), China
59	Petrobras, Brazil
60	Petroleos de Venezuela, Venezuela
61	Pemex, Mexico
62	Petroleum Development Oman, Oman
63	Petronas, Malaysia
64	Poland
65	Polish Oil & Gas, Poland
66	Qatar Petroleum, Qatar
67	Repsol, Spain
68	Rio Tinto, UK
69	Rosneft, Russian Federation
70	Royal Dutch Shell, The Netherlands & UK
71	Ruhrkohle AG (RAG), Germany
72	Russian Federation
73	RWE, Germany
74	Sasol, South Africa
75	Saudi Aramco, Saudi Arabia
76	Singareni Collieries, India
77	Sinopec, China
78	Sonangol, Angola
79	Sonatrach, Algeria
80	Statoil, Norway
81	Suncor, Canada
82	Syrian Petroleum, Syria
83	Taiheiyu, Japan
84	Talisman, Canada
85	Total, France
86	UK Coal, UK
87	Ukraine
88	Westmoreland Mining, USA
89	Xstrata, Switzerland
90	Yukos, Russia

	y	y	y	y	y
1,981	0.31%	8	168	2,149	
636	0.10%	3	54	690	
6,676	1.04%	27	566	7,242	
5,428	0.84%	22	460	5,888	
5,355	0.83%	22	454	5,808	
918	0.14%	4	78	996	
17,742	2.76%	72	1,503	19,245	
1,229	0.19%	5	104	1,333	
105,961	16.49%	428	8,978	114,939	
14,282	2.22%	58	1,210	15,493	
8,342	1.30%	34	707	9,049	
1,611	0.25%	7	137	1,748	
1,844	0.29%	7	156	2,000	
6,773	1.05%	27	574	7,347	
1,317	0.21%	5	112	1,429	
63,480	9.88%	256	5,378	68,858	
4,095	0.64%	17	347	4,442	
1,194	0.19%	5	101	1,295	
967	0.15%	4	82	1,049	
2,027	0.32%	8	172	2,199	
734	0.11%	3	62	796	
1,088	0.17%	4	92	1,181	
2,583	0.40%	10	219	2,802	
1,725	0.27%	7	146	1,871	
11,461	1.78%	46	971	12,432	
24,661	3.84%	99	2,089	26,750	
5,495	0.86%	22	466	5,961	
1,049	0.16%	4	89	1,138	
10,365	1.61%	42	878	11,243	
6,309	0.98%	25	535	6,843	
3,241	0.50%	13	275	3,515	
1,735	0.27%	7	147	1,882	
732	0.11%	3	62	794	
3,107	0.48%	13	263	3,370	
1,411	0.22%	6	120	1,530	
2,049	0.32%	8	174	2,223	
329,604	51.30%	1,330	27,926	357,530	

	y	y
551	1.69%	
9,150	28.14%	
587	1.80%	
1,008	3.10%	
463	1.42%	
1,044	3.21%	
402	1.24%	
13,205	40.61%	

Total CO2 & methane emissions

329,604 vertical check **51.30%** **1,330** **27,926** **357,530** vertical

13,205 vertical check **40.61%** vertical

This study, MtCO2
CDIAC emissions, MtCO2
Percent this study of total CDIAC 1751-2010

Coal CO2
329,604 This study, MtCO2e
642,500 CDIAC coal CO2
51.3% Percent of CDIAC

Coal Methane
27,926 This study, MtCO2e
74,222 CDIAC CH4, MtCO2e
37.6% Percent of CDIAC

Cement
13,205 This study, MtCO2e
32,519 CDIAC cement CO2
40.6% Percent of CDIAC

Summary of CO2 & methane emissions from identified fossil fuel & cement production

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Grand Total of emissions identified in this study

Rank	Entity	Total fuel and cement CO2 emissions			Emissions from flaring, venting, and fugitive methane					Total CO2 and methane		
		This study	This study	Percent of CDIAc	Flaring CO2	Vented CO2	Own fuel use	Fugitive methane	Fugitive methane	Total emissions	Percent of this study	% of CDIAc 1751-2010
		MtCO2	MtC	Percent	MtCO2	MtCO2	MtCO2	MtCH4	MtCO2e	MtCO2e	Percent	Percent

Rank	Entity	y			y					y		
		MtCO2	MtC	Percent	MtCO2	MtCO2	MtCO2	MtCH4	MtCO2e	MtCO2e	Percent	Percent
1	Abu Dhabi, United Arab Emirates	8,838	2,412	0.68%	123	65	76	27	571	9,672	1.06%	0.67%
2	Alpha Natural Resources, USA	1,981	541	0.15%				8	168	2,149	0.24%	0.15%
3	Anadarko, USA	4,556	1,243	0.35%	42	51	87	22	459	5,195	0.57%	0.36%
4	Anglo American, UK	6,676	1,822	0.52%				27	566	7,242	0.79%	0.50%
5	Apache, USA	808	221	0.06%	7	13	23	5	99	951	0.10%	0.07%
6	Arch Coal Company, USA	5,428	1,481	0.42%				22	460	5,888	0.64%	0.41%
7	Bahrain Petroleum Corporation	777	212	0.06%	6	14	27	5	107	931	0.10%	0.06%
8	BG Group (British Gas) UK	1,242	339	0.10%	6	28	56	10	209	1,543	0.17%	0.11%
9	BHP Billiton, Australia	6,966	1,901	0.54%	20	16	23	28	582	7,606	0.83%	0.52%
10	BP, UK	32,508	8,872	2.52%	423	262	338	110	2,307	35,837	3.92%	2.47%
11	British Coal Corporation, UK	17,742	4,842	1.37%				72	1,503	19,245	2.11%	1.33%
12	Canadian Natural Resources, Canada	825	225	0.06%	8	12	21	4	92	958	0.10%	0.07%
13	Cemex, Mexico	551	150	0.04%						551	0.06%	0.04%
14	ChevronTexaco, USA	46,277	12,629	3.59%	598	382	501	159	3,338	51,096	5.59%	3.52%
15	China, PR (coal & cement only)	115,111	31,415	8.92%				428	8,978	124,089	13.57%	8.56%
16	CNOOC, PR China	1,030	281	0.08%	15	7	8	3	64	1,123	0.12%	0.08%
17	Coal India, India	14,282	3,898	1.11%				58	1,210	15,493	1.69%	1.07%
18	ConocoPhillips, USA	14,697	4,011	1.14%	157	190	321	71	1,500	16,866	1.84%	1.16%
19	CONSOL Energy, USA	8,378	2,287	0.65%	0	1	2	34	714	9,096	0.99%	0.63%
20	Cyprus Amax, USA	1,611	440	0.12%				7	137	1,748	0.19%	0.12%
21	Czech Republic	1,844	503	0.14%				7	156	2,000	0.22%	0.14%
22	Czechoslovakia	6,773	1,849	0.52%				27	574	7,347	0.80%	0.51%
23	Devon Energy, USA	1,412	385	0.11%	11	26	48	9	193	1,690	0.18%	0.12%
24	Ecopetrol, Colombia	1,660	453	0.13%	23	12	12	5	102	1,809	0.20%	0.12%
25	Egyptian General Petroleum, Egypt	2,480	677	0.19%	31	24	35	9	199	2,768	0.30%	0.19%
26	EnCana, Canada	1,403	383	0.11%	10	27	52	10	203	1,695	0.19%	0.12%
27	ENI, Italy	5,196	1,418	0.40%	55	68	116	26	537	5,973	0.65%	0.41%
28	ExxonMobil, USA	41,603	11,354	3.22%	490	419	634	168	3,526	46,672	5.10%	3.22%
29	FSU (Former Soviet Union)	116,879	31,898	9.06%	597	648	1,063	502	10,532	129,717	14.19%	8.94%
30	Gazprom, Russia	25,090	6,847	1.94%	68	674	1,385	234	4,920	32,136	3.52%	2.22%
31	HeidelbergCement, Germany	587	160	0.05%						587	0.06%	0.04%
32	Hess, USA	2,094	571	0.16%	25	23	36	9	186	2,364	0.26%	0.16%
33	Holcim, Switzerland	1,008	275	0.08%						1,008	0.11%	0.07%
34	Husky, Canada	587	160	0.05%	7	7	11	3	54	665	0.07%	0.05%
35	Iraq National Oil Company, Iraq	6,702	1,829	0.52%	105	29	8	14	293	7,137	0.78%	0.49%
36	Italcementi	463	126	0.04%						463	0.05%	0.03%
37	Kazakhstan	4,095	1,117	0.32%				17	347	4,442	0.49%	0.31%
38	Kiewit Mining Group, USA	1,194	326	0.09%				5	101	1,295	0.14%	0.09%
39	Kuwait Petroleum Corp., Kuwait	9,800	2,675	0.76%	149	49	28	23	476	10,503	1.15%	0.72%
40	Lafarge, France	1,044	285	0.08%						1,044	0.11%	0.07%
41	Libya National Oil Corp., Libya	6,216	1,696	0.48%	93	35	26	15	324	6,693	0.73%	0.46%
42	Lukoil, Russia	3,598	982	0.28%	54	20	15	9	186	3,873	0.42%	0.27%
43	Luminant / TXU, USA	967	264	0.07%				4	82	1,049	0.11%	0.07%
44	Marathon, USA	2,639	720	0.20%	31	30	47	11	239	2,985	0.33%	0.21%
45	Massey Energy Corporation, US	2,027	553	0.16%				8	172	2,199	0.24%	0.15%
46	Murphy Oil, USA	369	101	0.03%	4	4	7	2	34	418	0.05%	0.03%
47	Murray Coal Corporation, USA	734	200	0.06%				3	62	796	0.09%	0.05%
48	National Iranian Oil Co., Iran	26,706	7,288	2.07%	380	183	193	77	1,623	29,084	3.18%	2.01%
49	Nexen, Canada	587	160	0.05%	8	5	7	2	44	651	0.07%	0.04%
50	Nigerian National Petroleum, Nigeria	6,061	1,654	0.47%	90	35	29	15	325	6,540	0.72%	0.45%
51	North American Coal, US	1,088	297	0.08%				4	92	1,181	0.13%	0.08%
52	North Korea	2,583	705	0.20%				10	219	2,802	0.31%	0.19%
53	Occidental, USA	4,633	1,264	0.36%	40	23	27	16	341	5,063	0.55%	0.35%
54	Oil and Gas Corp., India	3,708	1,012	0.29%	45	38	58	15	313	4,163	0.46%	0.29%
55	OMV Group, Austria	301	82	0.02%	3	4	7	1	31	346	0.04%	0.02%
56	Peabody Energy, USA	11,461	3,128	0.89%				46	971	12,432	1.36%	0.86%
57	Pertamina, Indonesia	6,164	1,682	0.48%	81	54	74	22	457	6,830	0.75%	0.47%
58	PetroChina (CNPC), China	9,673	2,640	0.75%	136	69	77	29	609	10,560	1.16%	0.73%
59	Petrobras, Brazil	5,493	1,499	0.43%	78	39	42	16	34	5,991	0.66%	0.41%
60	Petroleos de Venezuela, Venezuela	14,771	4,031	1.14%	206	108	124	45	947	16,157	1.77%	1.11%
61	Pemex, Mexico	18,139	4,950	1.41%	242	152	199	62	1,293	20,025	2.19%	1.38%
62	Petroleum Development Oman, Oman	2,395	654	0.19%	31	22	31	9	184	2,663	0.29%	0.18%
63	Petronas, Malaysia	4,557	1,244	0.35%	46	64	111	24	496	5,274	0.58%	0.36%
64	Poland	24,661	6,730	1.91%				99	2,089	26,750	2.93%	1.84%
65	Polish Oil & Gas, Poland	423	116	0.03%	5	4	6	2	34	473	0.05%	0.03%
66	Qatar Petroleum, Qatar	2,997	818	0.23%	34	36	58	14	285	3,410	0.37%	0.24%
67	Repsol, Spain	2,961	808	0.23%	33	37	60	14	290	3,381	0.37%	0.23%
68	Rio Tinto, UK	5,495	1,500	0.43%				22	466	5,961	0.65%	0.41%
69	Rosneft, Russian Federation	2,501	683	0.19%	36	17	18	7	151	2,723	0.30%	0.19%
70	Royal Dutch Shell, The Netherlands & UK	27,573	7,525	2.14%	348	264	380	104	2,186	30,751	3.36%	2.12%
71	Ruhrkohle AG (RAG), Germany	1,049	286	0.08%				4	89	1,138	0.12%	0.08%
72	Russian Federation	10,365	2,829	0.80%				42	878	11,243	1.23%	0.78%
73	RWE, Germany	6,309	1,722	0.49%				25	535	6,843	0.75%	0.47%
74	Sasol, South Africa	3,241	884	0.25%				13	275	3,515	0.38%	0.24%
75	Saudi Aramco, Saudi Arabia	42,820	11,686	3.32%	645	230	159	104	2,179	46,033	5.04%	3.17%
76	Singareni Collieries, India	1,735	474	0.13%				7	147	1,882	0.21%	0.13%
77	Sinopec, China	1,413	385	0.11%	20	9	9	4	81	1,532	0.17%	0.11%
78	Sonangol, Angola	1,688	461	0.13%	27	7	1	3	71	1,794	0.20%	0.12%
79	Sonatrach, Algeria	7,957	2,172	0.62%	77	117	207	43	905	9,263	1.01%	0.64%
80	Statoil, Norway	3,891	1,062	0.30%	48	40	60	16	327	4,367	0.48%	0.30%
81	Suncor, Canada	1,243	339	0.10%	15	14	22	5	113	1,407	0.15%	0.10%
82	Syrian Petroleum, Syria	1,290	352	0.10%	18	9	9	4	76	1,402	0.15%	0.10%
83	Taiheyo, Japan	402	110	0.03%						402	0.04%	0.03%
84	Talisman, Canada	794	217	0.06%						794	0.09%	0.06%
85	Total, France	10,790	2,945	0.84%	144	91	118	37	769	11,911	1.30%	0.82%
86	UK Coal, UK	732	200	0.06%				3	62	794	0.09%	0.05%
87	Ukraine	3,107	848	0.24%				13	263	3,370	0.37%	0.23%
88	Westmoreland Mining, USA	1,411	385	0.11%				6	120	1,530	0.17%	0.11%
89	Xstrata, Switzerland	2,049	559	0.16%				8	174	2,223	0.24%	0.15%
90	Yukos, Russia	2,686	733	0.21%	42	11	2	5	115	2,858	0.31%	0.20%

	Total CO2 & methane emissions	828,651	226,148	64.2%	6,040	4,829	7,115	3,220	67,616	914,251	100.0%	63.0%
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Total CO2: fossil fuels (excl. cement, flaring & vented)		Total CO2: fossil fuels, flaring, venting, cement		Total CO2 and methane	
This study, MtCO2	CDIAc emissions, MtCO2	This study, MtCO2	CDIAc, MtCO2	This study, MtCO2e	CDIAc, MtCO2e
815,446	1,290,566	846,635	1,335,686	914,251	1,450,332
63.19%	Percent of CDIAc	63.39%	Percent of CDIAc	63.04%	% of CDIAc

Cell: M9

Comment: Rick Heede:

This section sums emissions from combustion of produced crude oil and NGLs reported by identified oil and gas companies (including national oil and gas companies). Non-fuel uses of gas are accounted for, and IPCC coefficients are applied to net production and combustion. Emissions of CO2 from company energy use, vented CO2, flaring, and methane sources are also detailed below and in related worksheets. See production worksheets ("OilGasAdnoc-Encana.xls", "OilGasENI-NorskHydro.xls", "OilGasOxy-Shell.xls", and "OilGasSaudi-Yukos.xls") and production and emissions sums in "SumOil.xls" and "SumGas.xls" and "AncillaryCH4&CO2.xls" for production data, emissions estimates, results, and methodological discussion.

Cell: AA9

Comment: Rick Heede:

This section sums emissions from combustion of produced natural gas reported by identified oil and gas companies (including national oil and gas companies). Non-fuel uses of gas are accounted for, and IPCC coefficients are applied to net production and combustion. Emissions of CO2 from company energy use, vented CO2, flaring, and methane sources are also detailed below and in related worksheets. See production worksheets ("OilGasAdnoc-Encana.xls", "OilGasENI-NorskHydro.xls", "OilGasOxy-Shell.xls", and "OilGasSaudi-Yukos.xls") and production and emissions sums in "SumOil.xls" and "SumGas.xls" and "AncillaryCH4&CO2.xls" for production data, emissions estimates, results, and methodological discussion.

Cell: AL9

Comment: Rick Heede:

See production worksheets ("CoalAngloNorthAmerican.xls" and "CoalPeabodyXstrata.xls") and production and emissions sums in "SumCoal.xls" and "AncillaryCH4&CO2.xls" for production data, emissions estimates, results, and methodological discussion.

Cell: AP9

Comment: Rick Heede:

CMS methodology and results are shown in the worksheets "Cement.xls" and "SumCement.xls". CMS has included the largest six cement manufacturers plus PR China in an industry with relatively few large multinational companies meeting the threshold of > 10 MTC per year, hence our total is a fraction of CDIAC's estimated emissions of CO2 (the CDIAC estimates start in 1928). Most of this project's emissions estimates start in ~1990.

Cell: B19

Comment: Rick Heede:

This section sums all emissions from identified producers of crude oil (including NGLs), natural gas, coal, and cement manufacturing. Emissions are estimated from primary production data, and account for net non-fuel uses and other factors discussed throughout this assemblage of ~one hundred worksheets. This summary table also sums CO2 emissions from flaring, CO2 emissions from direct venting. CMS also sums emissions of methane associated with primary production and flaring in oil, gas, and coal operations, converts methane gas to CO2-equivalent (at IPCC SAR value of 21 x CO2). The table sums all emissions sources for each entity, and ranks total emissions in tonnes CO2e and as a percent of total identified emissions. Finally, all estimates are compared to global industrial emissions of CO2 and methane from the CDIAC database of CO2 emissions by fuel, cement, flaring, and methane from coal, oil, and natural gas operations.

Cell: H11

Comment: Rick Heede:

Flaring rates are calculated in the worksheet "AncillaryCH4&CO2.xls". In brief, flaring rate is computed for kg CO2 of flared associated gas per kg CO2 from oil combustion and is based on World Bank Global Gas Flaring Reduction data estimated from satellite reconnaissance. See the "Flaring and Venting" worksheet in the AncillaryCO2CH4.xls workbook.

Cell: I11

Comment: Rick Heede:

Recent data from the US EPA on venting from petroleum systems is used to compute vented CO2 as a function of CO2 from the combustion of oil and NGLs. See "Flaring and Venting" worksheet in AncillaryCH4&CO2.xls for details. CO2 vented from petroleum operations is small compared to CO2 venting from natural gas operations.

Cell: J11

Comment: Rick Heede:

The US EPA (2012) Draft Inventory of U.S Emissions and Sinks 2010 data on methane emissions from petroleum systems were used to develop a fugitive methane rate as a function of oil & NGL production and combustion (in kg CH4 per tonne CO2 from combusted liquids). See "Oil and Gas ancillary CH4" worksheet in AncillaryCH4&CO2.xls for details.

Cell: L11

Comment: Rick Heede:

The IPCC Second Assessment Report (SAR) GWP value for methane -- 21xCO2 -- is used throughout.

Cell: V11

Comment: Rick Heede:

CMS reviews numerous estimates of flaring emissions in the oil and gas industries in the worksheets in "AncillaryCH4&CO2.xls". CMS allocates flaring to both oil and gas production, with the preponderance (90 percent) to oil operations and 10 percent to gas operations to account for flaring at natural gas production, field processing, and processing plants. See "Flaring and Venting" worksheet in the "AncillaryCH4&CO2.xls" workbook for details.

Cell: W11

Comment: Rick Heede:

Recent US EPA (2012) estimates of CO2 vented from natural gas systems -- chiefly Acid Gas Removal vents at processing plants to meet market specifications -- as a function of CO2 from combusted natural gas in the U.S. 1990-2010. This factor is applied to global natural gas operations, though the CO2 content of raw produced gas varies widely from region to region.

See the "Flaring & Venting" worksheet in "AncillaryCH4&CO2.xls" for details.

Cell: X11

Comment: Rick Heede:

The US EPA (2006) Global Mitigation of Non-CO2 Gases data on methane emissions from natural gas systems were used to develop a fugitive methane rate as a function of natural gas production and combustion (in kg CH4 per tonne CO2 from combusted natural gas). See "Oil and Gas ancillary CH4" worksheet in AncillaryCH4&CO2.xls for details.

Cell: Y11

Comment: Rick Heede:

The IPCC Second Assessment Report (SAR) GWP value for methane -- 21xCO2 -- is used throughout.

Cell: Z11

Comment: Rick Heede:

Preliminary estimate based on flimsy quote (see dBase): "The only other major producer outside of CIL, is the Singareni Collieries Company that is located in Andhra Pradesh. Singareni contributes about 7-8 % of India's overall coal production, amounting to approximately 20 Mt each year." Thus if 20 Mt = (say) 8 percent and CIL = (say) 88 percent, then CIL is 11 x 20 Mt = 220 Mt coal. No adjustment here for lignite coal.

However, total Indian coal production was 385 Mshtons in 2001 = 349 Mt (=204 MtC).

Cell: A111

Comment: Rick Heede:

Stern and Kaufmann (1998) data on methane rates from coal mining were averaged with US EPA (2011) Global Anthropogenic Non-CO2 Greenhouse Gas Emissions and converted to a fugitive methane rate per tonne of CO2 from coal combustion: kg CH2/tCO2. See the "Coal ancillary CH4" worksheet in AncillaryCO2CH4.xls for details on the methodology.

Cell: AK11

Comment: Rick Heede:

The IPCC Second Assessment Report (SAR) GWP value for methane -- 21xCO2 -- is used throughout.

Cell: B12

Comment: Rick Heede:

Alphabetical rank.

Cell: BB115

Comment: Rick Heede (29 March 2012):

The CDIAC industrial carbon emissions worksheet rounds each fuel column independently, and the sum shown here is 1 MtC (and 3.7 MtCO2) higher than CDIAC's own sum. We do not correct this so as to not throw off the percentages calculated here.

Cell: B117

Comment: Rick Heede:

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