

A	B	C	D	E	F	G	H	I	J	K	L	M	N
<b>Summary of CO2 &amp; methane emissions from identified oil &amp; NGL production</b>													
Richard Heede Climate Mitigation Services 29-Jul-13													
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<b>Crude Oil &amp; Natural Gas Liquids</b>													
Production less sequestration      Ancillary emissions from flaring, venting, field use, refining and processing, etc.													
Rank	Entity	This study	Percent of CDIAC	Flaring CO2	Vented CO2	Fugitive methane	Fugitive methane	Total oil & NGL emissions					
		MtCO2	Percent	MtCO2	MtCO2	MtCH4	MtCO2e	MtCO2e					
		IPCC values (28Dec12)		15.94	3.833	1.924	EPA	40.39					
		IPCC values pasted:		15.19	3.651	10.080		211.7	IPCC SAR GWP 21xCO2				
		y	y	y	y	y	y	y	y				
1	FSU (Former Soviet Union)	35,462	7.51%	565	136	68	1,432	37,596					
2	China (coal & cement)												
3	Chevron, USA	36,583	7.75%	583	140	70	1,478	38,784					
4	ExxonMobil, USA	29,587	6.27%	472	113	57	1,195	31,367					
5	Saudi Aramco, Saudi Arabia	40,133	8.50%	640	154	77	1,621	42,548					
6	BP, UK	25,883	5.48%	413	99	50	1,045	27,440					
7	Gazprom, Russia	1,707	0.36%	27	7	3	69	1,810					
8	Royal Dutch Shell, The Netherlands & UK	21,157	4.48%	337	81	41	855	22,430					
9	National Iranian Oil Company, Iran	23,448	4.97%	374	90	45	947	24,859					
10	Poland												
11	Petroleos Mexicanos (PEMEX), Mexico	14,782	3.13%	236	57	28	597	15,671					
12	British Coal Corporation, UK												
13	ConocoPhillips, USA	9,271	1.96%	148	36	18	374	9,829					
14	Petroleos de Venezuela, Venezuela	12,673	2.68%	202	49	24	512	13,435					
15	Coal India, India												
16	Peabody Energy, USA												
17	Total, France	8,796	1.86%	140	34	17	355	9,326					
18	Russian Federation												
19	PetroChina, China	8,367	1.77%	133	32	16	338	8,871					
20	Kuwait Petroleum Corp., Kuwait	9,321	1.97%	149	36	18	377	9,882					
21	Abu Dhabi National Oil Corp., UAE	7,559	1.60%	121	29.0	15	305	8,014					
22	Sonatrach, Algeria	4,467	0.95%	71	17	9	180	4,736					
23	CONSOL Energy, USA												
24	BHP Billiton, Australia	1,230	0.26%	20	5	2	50	1,304					
25	Czechoslovakia												
26	Anglo American, UK												
27	Iraq National Oil Company, Iraq	6,567	1.39%	105	25	13	265	6,962					
28	RWE, Germany												
29	Pertamina, Indonesia	4,918	1.04%	78	19	9	199	5,214					
30	Libya National Oil Corp., Libya	5,780	1.22%	92	22	11	233	6,127					
31	Nigerian National Petroleum, Nigeria	5,580	1.18%	89	21	11	225	5,916					
32	Petrobras, Brazil	4,784	1.01%	76	18	9	193	5,071					
33	ENI, Italy	3,236	0.69%	52	12	6	131	3,431					
34	Rio Tinto, UK												
35	Arch Coal, USA												
36	Petronas, Malaysia	2,689	0.57%	43	10	5	109	2,851					
37	Anadarko, USA	2,445	0.52%	39	9	5	99	2,592					
38	Occidental, USA	2,446	0.52%	39	9	5	99	2,594					
39	Kazakhstan												
40	Statoil, Norway	2,872	0.61%	46	11	6	116	3,044					
41	Oil and Gas Corp., India	2,729	0.58%	44	10	5	110	2,894					
42	Lukoil, Russia	3,352	0.71%	53	13	6	135	3,533					
43	Sasol, South Africa												
44	Qatar Petroleum, Qatar	2,015	0.43%	32	8	4	81	2,136					
45	Repsol, Spain	1,942	0.41%	31	7	4	78	2,059					
46	Ukraine												
47	Marathon, USA	1,848	0.39%	29	7	4	75	1,959					
48	Yukos, Russia	2,645	0.56%	42	10	5	107	2,804					
49	North Korea												
50	Egyptian General Petroleum, Egypt	1,891	0.40%	30	7	4	76	2,005					
51	Rosneft, Russian Federation	2,201	0.47%	35	8	4	89	2,334					
52	Petroleum Development Oman, Oman	1,871	0.40%	30	7	4	76	1,983					
53	Hess, USA	1,486	0.31%	24	6	3	60	1,575					
54	Xstrata, Switzerland												
55	Massey Energy, US												
56	Alpha Natural Resources, USA												
57	Czech Republic												
58	Singareni Collieries, India												
59	Ecopetrol, Colombia	1,449	0.31%	23	6	3	59	1,537					
60	Sonangol, Angola	1,669	0.35%	27	6	3	67	1,769					
61	Cyprus Amax, USA												
62	EnCana, Canada	528	0.11%	8	2	1	21	559					
63	Devon Energy, USA	596	0.13%	10	2	1	24	632					
64	BG Group (British Gas) UK	291	0.06%	5	1	1	12	308					
65	Sinopec, China	1,269	0.27%	20	5	2	51	1,345					
66	Westmoreland Mining, USA												
67	Suncor, Canada	870	0.18%	14	3	2	35	922					
68	Syrian Petroleum, Syria	1,144	0.24%	18	4	2	46	1,213					
69	Kiewit Mining Group, USA												
70	North American Coal, US												
71	Ruhrkohle AG (RAG), Germany												
72	CNOOC, China	897	0.19%	14	3	2	36	951					
73	Luminant, USA												
74	Lafarge, France												
75	Holcim, Switzerland												
76	Canadian Natural Resources, Canada	477	0.10%	8	2	1	19	506					
77	Apache, USA	412	0.09%	7	2	1	17	436					
78	Bahrain Petroleum Corporation	323	0.07%	5	1	1	13	342					
79	Talisman, Canada	446	0.09%	7	2	1	18	473					
80	Murray Coal, USA												
81	UK Coal, UK												
82	Husky, Canada	407	0.09%	6	2	1	16	431					
83	Nexen, Canada	468	0.10%	7	2	1	19	496					
84	HeidelbergCement, Germany												
85	Cemex, Mexico												
86	Polish Oil & Gas, Poland	320	0.07%	5	1	1	13	339					
87	Italcementi												
88	Murphy Oil, USA	256	0.05%	4	1	0	10	271					
89	Taiheiyu, Japan												
90	OMV Group, Austria	186	0.04%	3	1	0	8	197					
<b>Total CO2 &amp; methane emissions</b>		<b>365,729</b>	<b>77.48%</b>	<b>5,831</b>	<b>1,402</b>	<b>703</b>	<b>14,773</b>	<b>387,735</b>					
		365,729	vertical check	1.50%	0.36%		vertical check	387,735					
		40.00%	of total				3.81%	100.00%					
<b>This study, MtCO2</b>		<b>365,729</b>	<b>This study, MtCO2</b>	<b>Flaring CO2</b>		<b>Vented CO2</b>							
<b>CDIAC emissions, MtCO2</b>		<b>472,012</b>	<b>CDIAC oil CO2</b>	<b>6,040</b>		<b>4,829</b>		<b>This study, MtCO2</b>					
<b>Percent this study of total CDIAC 1751-2010</b>		<b>77.48%</b>	<b>Percent of CDIAC</b>	<b>106.02%</b>		<b>126.017</b>		<b>Percent of CDIAC</b>					
				<b>percent</b>		<b>kgCO2e/tCO2</b>							
				<b>12,601</b>		<b>CDIAC Flaring CO2</b>		<b>CDIAC includes in gas CO2</b>					
				<b>47.93%</b>		<b>Percent of CDIAC</b>		<b>CDIAC Flaring CO2</b>					
				<b>na</b>		<b>Percent of CDIAC</b>							

O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
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## Summary of CO2 & methane emissions from identified natural gas production

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29-Jul-13

### 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	207.44	59.24	EPA
	IPCC values pasted:	kg CO2/tCO2: 1.525	kg CO2/tCO2: 25.08	kg CH4/tCO2: 3.708	kg CO2e/tCO2: 77.9	kg CO2e/tCO2:	IPCC SAR GWP 21xCO2

Rank

Entity

	y	y	10% of oil flaring	y	y	y	y	y	
1	FSU (Former Soviet Union)	17,937	10.19%	31.1	511.80	177.18	3,721	1,063	23,263
2	China (coal & cement)								
3	Chevron, USA	8,465	4.81%	14.7	241.54	83.62	1,756	501	10,979
4	ExxonMobil, USA	10,699	6.08%	18.6	305.28	105.69	2,219	634	13,876
5	Saudi Aramco, Saudi Arabia	2,687	1.53%	4.7	76.67	26.54	557	159	3,485
6	BP, UK	5,707	3.24%	9.9	162.83	56.37	1,184	338	7,401
7	Gazprom, Russia	23,383	13.28%	40.6	667.20	230.98	4,851	1,385	30,327
8	Royal Dutch Shell, The Netherlands & UK	6,416	3.64%	11.1	183.06	63.38	1,331	380	8,321
9	National Iranian Oil Company, Iran	3,258	1.85%	5.7	92.95	32.18	676	193	4,225
10	Poland								
11	Petroleos Mexicanos (PEMEX), Mexico	3,357	1.91%	5.8	95.79	33.16	696	199	4,354
12	British Coal Corporation, UK								
13	ConocoPhillips, USA	5,426	3.08%	9.4	154.81	53.60	1,126	321	7,037
14	Petroleos de Venezuela, Venezuela	2,099	1.19%	3.6	59.89	20.73	435	124	2,722
15	Coal India, India								
16	Peabody Energy, USA								
17	Total, France	1,994	1.13%	3.5	56.88	19.69	414	118	2,586
18	Russian Federation								
19	PetroChina, China	1,306	0.74%	2.3	37.25	12.90	271	77	1,693
20	Kuwait Petroleum Corp., Kuwait	479	0.27%	0.8	13.67	4.73	99	28	621
21	Abu Dhabi National Oil Corp., UAE	1,278	0.73%	2.2	36.48	12.63	265	76	1,658
22	Sonatrach, Algeria	3,491	1.98%	6.1	99.60	34.48	724	207	4,527
23	CONSOL Energy, USA	36	0.02%	0.1	1.03	0.36	8	2	47
24	BHP Billiton, Australia	380	0.22%	0.7	10.86	3.76	79	23	493
25	Czechoslovakia								
26	Anglo American, UK								
27	Iraq National Oil Company, Iraq	135	0.08%	0.2	3.85	1.33	28	8	175
28	RWE, Germany								
29	Pertamina, Indonesia	1,246	0.71%	2.2	35.55	12.31	258	74	1,616
30	Libya National Oil Corp., Libya	436	0.25%	0.8	12.44	4.31	90	26	566
31	Nigerian National Petroleum, Nigeria	482	0.27%	0.8	15.74	4.76	100	29	625
32	Petrobras, Brazil	709	0.40%	1.2	20.24	7.01	147	42	920
33	ENI, Italy	1,960	1.11%	3.4	55.92	19.36	407	116	2,542
34	Rio Tinto, UK								
35	Arch Coal, USA								
36	Petronas, Malaysia	1,869	1.06%	3.2	53.32	18.46	388	111	2,424
37	Anadarko, USA	1,475	0.84%	2.6	42.09	14.57	306	87	1,913
38	Occidental, USA	462	0.26%	0.8	13.17	4.56	96	27	599
39	Kazakhstan								
40	Statoil, Norway	1,019	0.58%	1.8	29.09	10.07	211	60	1,322
41	Oil and Gas Corp., India	978	0.56%	1.7	27.92	9.67	203	58	1,269
42	Lukoil, Russia	246	0.14%	0.4	7.03	2.43	51	15	320
43	Sasol, South Africa								
44	Qatar Petroleum, Qatar	982	0.56%	1.7	28.02	9.70	204	58	1,274
45	Repsol, Spain	1,019	0.58%	1.8	29.08	10.07	211	60	1,322
46	Ukraine								
47	Marathon, USA	791	0.45%	1.4	22.57	7.81	164	47	1,026
48	Yukos, Russia	41	0.02%	0.1	1.18	0.41	9	2	54
49	North Korea								
50	Egyptian General Petroleum, Egypt	589	0.33%	1.0	16.80	5.82	122	35	764
51	Rosneft, Russian Federation	300	0.17%	0.5	8.56	2.96	62	18	389
52	Petroleum Development Oman, Oman	524	0.30%	0.9	14.95	5.18	109	31	680
53	Hess, USA	608	0.35%	1.1	17.35	6.01	126	36	789
54	Xstrata, Switzerland								
55	Massey Energy, US								
56	Alpha Natural Resources, USA								
57	Czech Republic								
58	Singareni Collieries, India								
59	Ecopetrol, Colombia	210	0.12%	0.4	5.99	2.08	44	12	272
60	Sonangol, Angola	19	0.01%	0.0	0.53	0.18	4	1	24
61	Cyprus Amax, USA								
62	EnCana, Canada	876	0.50%	1.5	24.98	8.65	182	52	1,136
63	Devon Energy, USA	816	0.46%	1.4	23.28	8.06	169	48	1,058
64	BG Group (British Gas) UK	952	0.54%	1.7	27.16	9.40	197	56	1,234
65	Sinopec, China	144	0.08%	0.2	4.10	1.42	30	9	186
66	Westmoreland Mining, USA								
67	Suncor, Canada	373	0.21%	0.6	10.65	3.69	77	22	484
68	Syrian Petroleum, Syria	146	0.08%	0.3	4.16	1.44	30	9	189
69	Kiewit Mining Group, USA								
70	North American Coal, US								
71	Ruhrkohle AG (RAG), Germany								
72	CNOOC, China	133	0.08%	0.2	3.79	1.31	28	8	172
73	Luminant, USA								
74	Lafarge, France								
75	Holcim, Switzerland								
76	Canadian Natural Resources, Canada	348	0.20%	0.6	9.93	3.44	72	21	452
77	Apache, USA	397	0.23%	0.7	11.32	3.92	82	23	514
78	Bahrain Petroleum Corporation	454	0.26%	0.8	12.95	4.48	94	27	588
79	Talisman, Canada	349	0.20%	0.6	9.95	3.44	72	21	452
80	Murray Coal, USA								
81	UK Coal, UK								
82	Husky, Canada	180	0.10%	0.3	5.14	1.78	37	11	234
83	Nexen, Canada	119	0.07%	0.2	3.39	1.17	25	7	154
84	HeidelbergCement, Germany								
85	Cemex, Mexico								
86	Polish Oil & Gas, Poland	103	0.06%	0.2	2.95	1.02	21	6	134
87	Italcementi								
88	Murphy Oil, USA	113	0.06%	0.2	3.24	1.12	24	7	147
89	Taiheyo, Japan								
90	OMV Group, Austria	115	0.07%	0.2	3.27	1.13	24	7	149

Total CO2 & methane emissions

120,113	68.22%	208	3,427	1,187	24,917	7,115	155,781
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120,113	vertical check	0.13%	2.20%	15.99%	4.57%	100.00%
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13.14% of total

This study, MtCO2	CDIAC emissions, MtCO2	Percent this study of total CDIAC 1751-2010	Natural Gas CO2	Total EF/Combustion EF:	Total Methane	Oil and Natural Gas methane rate
120,113	176,055	68.22%	120,113	123.77%	67,616	365,729
	CDIAC gas CO2		linked to SumGas.xls	percent	This study, MtCO2e	million tCO2
				1,237.71	114,646	1.924
				kgCO2e/tCO2	CDIAC CH4, MtCO2e	kgCH4/tCO2
					58,978%	9.878
					Percent of CDIAC	485,842
						3,890

AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ
<b>Summary of CO2 &amp; methane emissions from identified coal and cement production</b>														
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<b>Coal</b>														
<b>Coal CO2 emissions</b> <b>Fugitive methane emissions</b>														
<b>This study</b> <b>Percent of CDIAC</b> <b>Fugitive methane</b> <b>Fugitive methane</b> <b>Total coal emissions</b>														
<b>MtCO2</b> <b>Percent</b> <b>MtCH4</b> <b>MtCO2e</b> <b>MtCO2e</b>														
IPCC values (22Dec12)      kg CH4/tCO2      4,035      kg CO2e/tCO2      84.73														
IPCC values pasted:      4.03      84.73      IPCC SAR GWP 21xCO2														
<b>Cement production</b>														
<b>Calculining emissions</b>														
<b>Cement</b> <b>Percent of CDIAC</b>														
<b>MtCO2</b> <b>Percent</b>														
<b>Rank</b>	<b>Entity</b>													
1	FSU (Former Soviet Union)	63,480	9.88%	256	5,378	68,858								
2	China (coal & cement)	105,961	16.49%	428	8,978	114,939	9,150	28.14%						
3	Chevron, USA	1,229	0.19%	5	104	1,333								
4	ExxonMobil, USA	1,317	0.21%	5	112	1,429								
5	Saudi Aramco, Saudi Arabia													
6	BP, UK	918	0.14%	4	78	996								
7	Gazprom, Russia													
8	Royal Dutch Shell, The Netherlands & UK													
9	National Iranian Oil Company, Iran													
10	Poland	24,661	3.84%	99	2,089	26,750								
11	Petroleos Mexicanos (PEMEX), Mexico													
12	British Coal Corporation, UK	17,742	2.76%	72	1,503	19,245								
13	ConocoPhillips, USA													
14	Petroleos de Venezuela, Venezuela													
15	Coal India, India	14,282	2.22%	58	1,210	15,493								
16	Peabody Energy, USA	11,461	1.78%	46	971	12,432								
17	Total, France													
18	Russian Federation	10,365	1.61%	42	878	11,243								
19	PetroChina, China													
20	Kuwait Petroleum Corp., Kuwait													
21	Abu Dhabi National Oil Corp., UAE													
22	Sonatrach, Algeria													
23	CONSOL Energy, USA	8,342	1.30%	34	707	9,049								
24	BHP Billiton, Australia	5,355	0.83%	22	454	5,808								
25	Czechoslovakia	6,773	1.05%	27	574	7,347								
26	Anglo American, UK	6,676	1.04%	27	566	7,242								
27	Iraq National Oil Company, Iraq													
28	RWE, Germany	6,309	0.98%	25	535	6,843								
29	Pertamina, Indonesia													
30	Libya National Oil Corp., Libya													
31	Nigerian National Petroleum, Nigeria													
32	Petrolbras, Brazil													
34	ENI, Italy													
33	Rio Tinto, UK	5,495	0.86%	22	466	5,961								
35	Arch Coal, USA	5,428	0.84%	22	460	5,888								
36	Petronas, Malaysia													
37	Anadarko, USA	636	0.10%	3	54	690								
38	Occidental, USA	1,725	0.27%	7	146	1,871								
39	Kazakhstan	4,095	0.64%	17	347	4,442								
40	Statoil, Norway													
41	Oil and Gas Corp., India													
42	Lukoil, Russia													
43	Sasol, South Africa	3,241	0.50%	13	275	3,515								
44	Qatar Petroleum, Qatar													
46	Repsol, Spain													
45	Ukraine	3,107	0.48%	13	263	3,370								
47	Marathon, USA													
48	Yukos, Russia													
49	North Korea	2,583	0.40%	10	219	2,802								
50	Egyptian General Petroleum, Egypt													
51	Rosneft, Russian Federation													
52	Petroleum Development Oman, Oman													
53	Hess, USA													
54	Xstrata, Switzerland	2,049	0.32%	8	174	2,223								
55	Massey Energy, US	2,027	0.32%	8	172	2,199								
56	Alpha Natural Resources, USA	1,961	0.31%	8	168	2,149								
74	Czech Republic	1,844	0.29%	7	156	2,000								
57	Singareni Collieries, India	1,735	0.27%	7	147	1,882								
58	Ecopetrol, Colombia													
59	Sonangol, Angola													
61	Cyprus Amax, USA	1,611	0.25%	7	137	1,748								
62	EnCana, Canada													
63	Devon Energy, USA													
64	BG Group (British Gas) UK													
65	Sinopec, China													
66	Westmoreland Mining, USA	1,411	0.22%	6	120	1,530								
67	Suncor, Canada													
68	Syrian Petroleum, Syria													
69	Kiewit Mining Group, USA	1,194	0.19%	5	101	1,295								
70	North American Coal, US	1,088	0.17%	4	92	1,181								
71	Ruhrkohle AG (RAG), Germany	1,049	0.16%	4	89	1,138								
72	CNOOC, China													
73	Luminant, USA	967	0.15%	4	82	1,049								
74	Lafarge, France													
92	Holcim, Switzerland						1,044	3.21%						
93	Canadian Natural Resources, Canada						1,008	3.10%						
94	Apache, USA													
95	Bahrain Petroleum Corporation													
96	Talisman, Canada													
97	Murray Coal, USA													
80	UK Coal, UK	734	0.11%	3	62	796								
81	Husky, Canada	732	0.11%	3	62	794								
82	Nexen, Canada													
83	HeidelbergCement, Germany													
84	Cemex, Mexico													
85	Polish Oil & Gas, Poland													
86	Italcementi													
87	Murphy Oil, USA													
88	Taiheyo, Japan													
89	OMV Group, Austria													
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	<b>Total CO2 &amp; methane emissions</b>	<b>329,604</b>	<b>51%</b>	<b>1,330</b>	<b>27,926</b>	<b>357,530</b>	<b>13,205</b>	<b>41%</b>						
		329,604 vertical check				357,530 vertical	13,205 vertical check							
		92.19%				7.81%	1.44%							
		36.05% of total				8.47%								
	<b>Coal CO2</b>	<b>329,604</b>	<b>This study, MtCO2e</b>	<b>Total EF/Combustion EF:</b>	<b>Coal Methane</b>	<b>This study, MtCO2e</b>	<b>Cement</b>	<b>This study, MtCO2e</b>						
		642,500	CDIAC coal CO2	percent 108.47%	27,926	CDIAC CH4, MtCO2e	13,205	CDIAC cement CO2						
		linked to SumCoal.xls		1,084.73	linked to CDIAC.xls		linked to SumCement.xls							
				kgCO2e/tCO2										
	<b>Percent this study of total CDIAC 1751-2010</b>	<b>51.30%</b>	<b>Percent of CDIAC</b>		<b>38.34%</b>	<b>Percent of CDIAC</b>	<b>40.61%</b>	<b>Percent of CDIAC</b>						

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

Copyright Climate Mitigation Services

Richard Heede  
Climate Mitigation Services  
29-Jul-13

## 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	MtCO2e	MtCH4	MtCO2e	MtCO2e	Percent	Percent
1	FSU (Former Soviet Union)	116,879	31,898	8.75%	597	648	1,063	502	10,532	129,717	14.19%	8.94%
2	China (coal & cement)	115,111	31,415	8.62%				428	8,978	124,089	13.57%	8.56%
3	Chevron, USA	46,277	12,629	3.46%	598	382	501	159	3,338	51,096	5.59%	3.52%
4	ExxonMobil, USA	41,603	11,354	3.11%	490	419	634	168	3,526	46,672	5.10%	3.22%
5	Saudi Aramco, Saudi Arabia	42,820	11,686	3.21%	645	230	159	104	2,179	46,033	5.04%	3.17%
6	BP, UK	32,508	8,872	2.43%	423	262	338	110	2,307	35,837	3.92%	2.47%
7	Gazprom, Russia	25,090	6,847	1.89%	68	674	1,385	234	4,920	32,136	3.52%	2.22%
8	Royal Dutch Shell, The Netherlands & UK	27,573	7,525	2.06%	348	264	380	104	2,186	30,751	3.36%	2.12%
9	National Iranian Oil Company, Iran	26,706	7,288	2.00%	380	183	193	77	1,623	29,084	3.18%	2.01%
10	Poland	24,661	6,730	1.85%				99	2,089	26,750	2.93%	1.84%
11	Petroleos Mexicanos (PEMEX), Mexico	18,139	4,950	1.36%	242	152	199	62	1,293	20,025	2.19%	1.38%
12	British Coal Corporation, UK	17,742	4,842	1.33%				72	1,503	19,245	2.11%	1.33%
13	ConocoPhillips, USA	14,697	4,011	1.10%	157	190	321	71	1,500	16,866	1.84%	1.16%
14	Petroleos de Venezuela, Venezuela	14,771	4,031	1.11%	206	108	124	45	947	16,157	1.77%	1.11%
15	Coal India, India	14,282	3,898	1.07%				58	1,210	15,493	1.69%	1.07%
16	Peabody Energy, USA	11,461	3,128	0.86%				46	971	12,432	1.36%	0.86%
17	Total, France	10,790	2,945	0.81%	144	91	118	37	769	11,911	1.30%	0.82%
18	Russian Federation	10,365	2,829	0.78%				42	878	11,243	1.23%	0.78%
19	PetroChina, China	9,673	2,640	0.72%	136	69	77	29	609	10,564	1.16%	0.73%
20	Kuwait Petroleum Corp., Kuwait	9,800	2,675	0.73%	149	49	28	23	476	10,503	1.15%	0.72%
21	Abu Dhabi National Oil Corp., UAE	8,838	2,412	0.66%	73	65	76	27	571	9,672	1.06%	0.67%
22	Sonatrach, Algeria	7,957	2,172	0.60%	177	117	207	43	905	9,263	1.01%	0.64%
23	CONSOL Energy, USA	8,378	2,287	0.63%	0	1	2	34	714	9,096	0.99%	0.63%
24	BHP Billiton, Australia	6,966	1,901	0.52%	20	16	23	28	582	7,606	0.83%	0.52%
25	Czechoslovakia	6,773	1,849	0.51%				28	574	7,347	0.80%	0.51%
26	Anglo American, UK	6,676	1,822	0.50%				27	566	7,242	0.79%	0.50%
27	Iraq National Oil Company, Iraq	6,702	1,829	0.50%	105	29	8	14	293	7,137	0.78%	0.49%
28	RWE, Germany	6,309	1,722	0.47%				25	535	6,843	0.75%	0.47%
29	Pertamina, Indonesia	6,164	1,682	0.46%	81	54	74	22	457	6,830	0.75%	0.47%
30	Libya National Oil Corp., Libya	6,216	1,696	0.47%	93	35	26	15	324	6,693	0.73%	0.46%
31	Nigerian National Petroleum, Nigeria	6,061	1,654	0.45%	90	35	29	15	325	6,540	0.72%	0.45%
32	Petrobras, Brazil	5,493	1,499	0.41%	78	39	42	16	340	5,991	0.66%	0.41%
33	ENI, Italy	5,196	1,418	0.39%	55	68	116	26	537	5,973	0.65%	0.41%
34	Rio Tinto, UK	5,495	1,500	0.41%				22	466	5,961	0.65%	0.41%
35	Arch Coal, USA	5,428	1,481	0.41%				22	460	5,888	0.64%	0.41%
36	Petronas, Malaysia	4,557	1,244	0.34%	46	64	111	24	496	5,274	0.58%	0.36%
37	Anadarko, USA	4,556	1,243	0.34%	42	51	87	22	459	5,195	0.57%	0.36%
38	Occidental, USA	4,633	1,264	0.35%	40	23	27	16	341	5,063	0.55%	0.35%
39	Kazakhstan	4,095	1,117	0.31%				17	347	4,442	0.49%	0.31%
40	Statoil, Norway	3,891	1,062	0.29%	48	40	60	16	327	4,367	0.48%	0.30%
41	Oil and Gas Corp., India	3,708	1,012	0.28%	45	38	58	15	313	4,163	0.46%	0.29%
42	Lukoil, Russia	3,598	982	0.27%	54	20	15	9	186	3,873	0.42%	0.27%
43	Sasol, South Africa	3,241	864	0.24%				13	275	3,515	0.38%	0.24%
44	Qatar Petroleum, Qatar	2,997	818	0.22%	34	36	58	14	285	3,410	0.37%	0.24%
45	Repsol, Spain	2,961	808	0.22%	33	37	60	14	290	3,381	0.37%	0.23%
46	Ukraine	3,107	848	0.23%				13	263	3,370	0.37%	0.23%
47	Marathon, USA	2,639	720	0.20%	31	30	47	11	239	2,985	0.33%	0.21%
48	Yukos, Russia	2,686	733	0.20%	42	11	2	5	115	2,858	0.31%	0.20%
49	North Korea	2,583	705	0.19%				10	219	2,802	0.31%	0.19%
50	Egyptian General Petroleum, Egypt	2,480	677	0.19%	31	24	35	9	199	2,768	0.30%	0.19%
51	Rosneft, Russian Federation	2,501	683	0.19%	36	17	18	7	151	2,723	0.30%	0.19%
52	Petroleum Development Oman, Oman	2,395	654	0.18%	31	22	31	9	184	2,663	0.29%	0.18%
53	Hess, USA	2,094	571	0.16%	25	23	36	9	186	2,364	0.26%	0.16%
54	Xstrata, Switzerland	2,049	559	0.15%				8	174	2,223	0.24%	0.15%
55	Massey Energy, US	2,027	553	0.15%				8	172	2,199	0.24%	0.15%
56	Alpha Natural Resources, USA	1,981	541	0.15%				8	168	2,149	0.24%	0.15%
57	Czech Republic	1,844	503	0.14%				7	156	2,000	0.22%	0.14%
58	Singapore Collieries, India	1,735	474	0.13%				7	147	1,882	0.21%	0.13%
59	Ecopetrol, Colombia	1,660	453	0.12%	23	12	12	5	102	1,809	0.20%	0.12%
60	Sonangol, Angola	1,688	461	0.13%	27	7	1	3	71	1,794	0.20%	0.12%
61	Cyprus Amax, USA	1,611	440	0.12%				7	137	1,748	0.19%	0.12%
62	EnCana, Canada	1,403	383	0.11%	10	27	52	10	203	1,695	0.19%	0.12%
63	Devon Energy, USA	1,412	385	0.11%	11	26	48	9	193	1,690	0.18%	0.12%
64	BG Group (British Gas) UK	1,242	339	0.09%	6	28	56	10	209	1,543	0.17%	0.11%
65	Sinopec, China	1,413	385	0.11%	20	9	9	4	81	1,532	0.17%	0.11%
66	Westmoreland Mining, USA	1,411	385	0.11%				6	120	1,530	0.17%	0.11%
67	Suncor, Canada	1,243	339	0.09%	15	14	22	5	113	1,407	0.15%	0.10%
68	Syrian Petroleum, Syria	1,290	352	0.10%	18	9	9	4	76	1,402	0.15%	0.10%
69	Kiewit Mining Group, USA	1,194	326	0.09%				5	101	1,295	0.14%	0.09%
70	North American Coal, US	1,088	297	0.08%				4	92	1,181	0.13%	0.08%
71	Ruhrkohle AG (RAG), Germany	1,049	286	0.08%				4	89	1,138	0.12%	0.08%
72	CNOOC, China	1,030	281	0.08%	15	7	8	3	64	1,123	0.12%	0.08%
73	Luminant, USA	967	264	0.07%				4	82	1,049	0.11%	0.07%
74	Lafarge, France	1,044	285	0.08%						1,044	0.11%	0.07%
75	Holcim, Switzerland	1,008	275	0.08%						1,008	0.11%	0.07%
76	Canadian Natural Resources, Canada	825	225	0.06%	8	12	21	4	92	958	0.10%	0.07%
77	Apache, USA	808	221	0.06%	7	13	23	5	99	951	0.10%	0.07%
78	Bahrain Petroleum Corporation	777	212	0.06%	6	14	27	5	107	931	0.10%	0.06%
79	Talisman, Canada	794	217	0.06%	8	12	21	4	90	925	0.10%	0.06%
80	Murray Coal, USA	734	200	0.05%				3	62	796	0.09%	0.05%
81	UK Coal, UK	752	200	0.05%				3	62	794	0.09%	0.05%
82	Husky, Canada	587	160	0.04%	7	7	11	3	54	665	0.07%	0.04%
83	Nexen, Canada	587	160	0.04%	8	5	7	2	44	651	0.07%	0.04%
84	HeidelbergCement, Germany	587	160	0.04%						587	0.06%	0.04%
85	Cemex, Mexico	551	150	0.04%						551	0.06%	0.04%
86	Polish Oil & Gas, Poland	423	116	0.03%	5	4	6	2	34	473	0.05%	0.03%
87	Italcementi	463	126	0.03%						463	0.05%	0.03%
88	Murphy Oil, USA	369	101	0.03%	4	4	7	2	34	418	0.05%	0.03%
89	Taiheyo, Japan	402	110	0.03%						402	0.04%	0.03%
90	OMV Group, Austria	301	82	0.02%	3	4	7	1	31	346	0.04%	0.02%

<b>Total CO2 &amp; methane emissions</b>	<b>828,651</b>	<b>226,148</b>	<b>62.04%</b>	<b>6,040</b>	<b>4,829</b>	<b>7,115</b>	<b>3,220</b>	<b>67,616</b>	<b>914,251</b>	<b>100.0%</b>	<b>63.04%</b>
	828,651	vertical check		0.66%	0.53%	0.78%		67,616	914,251	vertical check	
(all CO2: combustion, venting, flaring, own fuel, minus cement)	833,430							7,40%	100.00%	of total	
<b>Total CO2: fossil fuels (excl. cement, flaring &amp; vented)</b>	<b>815,446</b>	<b>This study: oil, gas, coal combustion</b>									



Sum Ranking

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-energy 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 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-energy 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 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-energy 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, and emissions of methane associated with primary production and flaring in oil, gas, and coal operations. Methane gas is converted 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 IPCC Tier 1 default values. See the "Flaring and Venting" worksheet in the AncillaryCO2CH4.xls workbook for details.

Cell: I11

**Comment:** Rick Heede:

Recent data from the IPCC 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 to natural gas flared at oil operations based on IPCC Tier 1 default values.  
See "Flaring and Venting" worksheet in the "AncillaryCH4&CO2.xls" workbook for details.

Cell: W11

**Comment:** Rick Heede:

Vented CO2 from natural gas processing -- chiefly Acid Gas Removal vents at processing plants to meet market specifications -- based on IPCC Tier 1 default values. 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 (2012) 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.  
U.S. Environmental Protection Agency (2012) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2010, 481 pp., 15 April 2012; [www.epa.gov/climatechange/emissions/usinventoryreport.html](http://www.epa.gov/climatechange/emissions/usinventoryreport.html)

Cell: Y11

**Comment:** Rick Heede:

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

Cell: Z11

**Comment:** Rick Heede:

Globally ~600 Mtoe used in oil and natural gas supply chain, 2004. Compare total production, 2004: 3,879 Mtoe oil, 2,427 Mtoe gas (excl flared gas), total 6,306 Mtoe. IPIECA estimates that 9.5 to 10 percent of world oil and gas production is consumed in the oil and gas supply chain for production, refineries, pipelines, LNG, processing, and transportation. IPIECA, 2007, p. 4.  
International Petroleum Industry Environmental Conservation Association (2007) Saving Energy in the Oil and Gas Industry, IPIECA, London, 17 pp.  
CMS analyzed ten oil and gas companies (Royal Dutch Shell, Hess, BP, ExxonMobil, ConocoPhillips, Statoil, Petrobras, Chevron, Total, and ENI) GHG submissions to the Carbon Disclosure Project ([www.cdproject.net](http://www.cdproject.net)). Of the five companies that provided sufficient detail on Scope 1 "combustion emissions" (thus ignoring flaring, process emissions, vented and fugitive emissions), the average company emitted 10.3 percent as scope 1 combustion emissions compared to the emissions from its oil and gas products, or 103 kg CO2/tCO2 from product emissions. However, CMS has already accounted for the full supply chain of oil production through to combustion of marketed products. We therefore isolate the natural gas proportion of oil and gas producers' energy inputs, which, according to IPIECA (IEA data), comprises 48 percent of total energy inputs, with oil products (such as pet coke, diesel, bunker fuel, refinery gas, residual fuel) supplying 42 percent; the 10 percent remainder is imported electricity and steam. Thus, of the direct fuel inputs, natural gas supplies 53.3 percent and oil products supply 46.7 percent.  
See "Entity CDP Scopes 1-3" worksheet in AncillaryCH4&CO2.xls for details, and discussion in Methods & Results Report, Annex B: Methodology.

Cell: A111

**Comment:** Rick Heede:

IPCC Tier 1 default values on methane emissions from coal mining were used to develop a methane rate per tCO2 from coal combustion, including surface and underground mines and post-mining emissions. See the Methodology report and "Coal ancillary CH4" worksheet in AncillaryCO2CH4.xls for details.

Cell: AK11

**Comment:** Rick Heede:

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

Cell: B12

**Comment:** Rick Heede:

Ranking is based on total emissions of CO2 and methane (column BE).

Cell: D12

**Comment:** Rick Heede:

CMS has identified a total of 88 company, multinational, and state entities that produce the majority of global carbon dioxide emissions from fossil fuel and cement manufacturing in 2010 as well as cumulatively. (Note: See worksheet "SumSum.xls" for the emissions from identified entities by year from 1854 through 2010.

Cell: I113

**Comment:** Rick Heede:

This study's estimate of flaring emissions from all sources (oil and natural gas; CO2 from coal mines are minor and typically not quantified) is compared to CDIAC's historic total. CDIAC begins the flaring dataset in 1950.

Cell: L113

**Comment:** Rick Heede:

Vented CO2 is estimated in this study, based on IPCC Tier default values (see AncillaryCO2&CH4.xls). CDIAC, however, does not estimate vented CO2 separately -- instead including a small factor within natural gas combustion estimates (See Marland & Rotty, 1984, Tellus).

Cell: X113

**Comment:** Rick Heede:

This study's total fugitive and vented methane from oil and natural gas systems and coal mining are summed here and compared to CDIAC's estimate for 1860 to 1969 (Stern & Kaufmann, 1998). CDIAC estimates are average with verisimilar EDGAR estimates for 1970-1995. EDGAR estimates for 1995-2008, plus 2009 and 2010 extrapolated by CMS.

Cell: AK113

Comment: Rick Heede:

Total methane from coal mining, based on Stern & Kaufmann (1998) CH4 estimates 1860-1994. CMS extrapolates for 1995-2010.

Note: the EDGAR methane estimates are an average of 45 percent lower than the S & K estimates for the overlap years 1970-1994.

Note: the coal methane rate used in the carbon majors study is close to the average value of the EDGAR estimates (3.64 kg CH4/tCO2 from coal combustion). See the final report for details.

Cell: BG113

Comment: Rick Heede:

This study's cumulative historic emissions of CO2 and methane attributed to all 88 entities 1854 to 2010 is compared to CDIAC's total 1971-2010.

Cell: CM116

Comment: Rick Heede:

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Cell: CM118

Comment: Rick Heede:

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