

Entity emissions from combustion, venting, flaring, and fugitive methane

Richard Heede
Climate Accountability Institute
18-Oct-20

Gazprom, Russian Federation

	DR	DS	DT	DU	DV	DW	DX	DY	DZ	EA	EB	EC	ED	EE	EF	EG	EH	EI	EJ	EK	EL	EM	EN	EO	EP	EQ	ER	ES	ET	EU	EV	EW	EX	EY	EZ	FA	FB	FC	
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10	1960s					1970s										1980s										1990s													
11	1965	1966	1967	1968	1969	1970	1971	1972	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	1999	2000	2001	2002	
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48	11,282	11,807	12,184	12,849	13,705	14,840	15,440	16,158	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	22,232	22,547	23,032	22,313	22,580	22,742	23,232	23,963	24,103	24,018	24,326	25,025	25,235	25,788	
49	3,079	3,222	3,325	3,507	3,740	4,050	4,214	4,410	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	6,639	6,830	6,887	7,038	
50																																							
51	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	6.10%	6.15%	5.99%	5.93%	5.66%	5.52%	5.38%	4.97%	4.75%	4.98%	4.91%	4.60%	4.51%	4.57%
52																																							
53																																							
54	51.3	53.4	54.7	57.2	60.6	66.8	92.3	99.4	112.6	112.5	105.2	117.3	114.8	122.9	119.4	110.5	93.4	92.8	89.4	86.3	87.0	86.8	84.9	92.0	93.2	90.0	89.1	89.9	89.7	90.1	89.9	91.9	89.3	84.0	82.0	82.6	83.0	82.8	
55																																							
56	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	12.96%	13.74%	13.81%	13.13%	12.69%	12.42%	12.22%	11.34%	11.12%	12.28%	12.60%	12.01%	11.72%	12.02%
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	FD	FE	FF	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	GF	GG	GH	GI	GJ	GK	GL	
1	Entity emissions from combustion, venting, flaring, and fugitive methane																																			
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9																																				
10	2000s										2010s										Cumulative		Entity emissions													
11	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	MtCO2e		Entity emissions															
12																					(except where noted)		(V = verified)													
13																																				
14																																				
15	117	127	112	124	123	117	114	118	121	126	155	158	162	172	176	162	2,937		Entity CO2 emissions				kg CO2/tCO2													
16	1,023	1,046	1,049	1,049	1,035	1,037	871	960	968	919	922	840	792	793	891	992	30,498		Oil & NGLs				MtCO2													
17																					-		Natural Gas				MtCO2				linked					
18																					-		Coal				MtCO2				linked					
19	1,140	1,173	1,161	1,173	1,158	1,154	984	1,078	1,089	1,045	1,077	997	953	964	1,067	1,154	33,435		Combustion total				MtCO2													
20																					-		Venting & Flaring total				MtCO2				sum					
21	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	11		Oil & NGLs: Venting				MtCO2													
22	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	47		Oil & NGLs: Flaring				MtCO2													
23	59	60	60	60	59	59	50	55	55	53	53	48	45	45	51	57	1,746		Own fuel use				MtCO2													
24	29	30	30	30	30	30	25	27	28	26	26	24	23	23	25	28	870		Natural Gas: Venting				MtCO2													
25	2	2	2	2	2	2	2	2	2	2	1	1	1	1	2	2	53		Natural Gas: Flaring				MtCO2													
26	92	94	94	94	93	93	78	86	87	83	84	77	72	73	81	90	2,728		Venting & Flaring total				MtCO2													
27																					-		Cement				MtCO2				linked					
28																					-		Total CO2 emissions				MtCO2				sum					
29	1,232	1,267	1,256	1,267	1,251	1,247	1,063	1,164	1,176	1,128	1,161	1,074	1,026	1,037	1,148	1,244	36,163		Total CO2 emissions				MtCO2													
30																					-		Total attributed emissions				MtCO2e				sum					
31																																				
32																																				
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6		Entity methane emissions				kg CH4/tCO2													
34	10	10	10	10	10	10	9	9	10	9	9	8	8	8	9	10	301		Methane: Oil & NGLs				MtCH4													
35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		Methane: Natural Gas				MtCH4													
36	10	11	11	11	10	10	9	10	10	9	9	9	8	8	9	10	307		Methane: Coal				MtCH4													
37																					-		Total methane emissions				MtCH4				sum					
38																																				
39	6	7	6	7	7	6	6	6	7	7	8	9	9	9	9	9	158		Entity methane emissions				GWP													
40	283	289	290	290	286	287	241	265	268	254	255	232	219	219	246	274	8,436		Methane: Oil & NGLs				MtCO2e													
41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		Methane: Natural Gas				MtCO2e													
42	289	296	296	297	293	293	247	272	274	261	263	241	228	229	256	283	8,594		Methane: Coal				MtCO2e													
43																					-		Total methane emissions				MtCO2e				sum					
44																																				
45	1,521	1,563	1,552	1,564	1,544	1,540	1,310	1,436	1,451	1,389	1,424	1,315	1,253	1,266	1,404	1,527	44,757		Total attributed emissions				MtCO2e													
46																					-		Total attributed emissions				MtCO2e				sum					
47	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		CDIAC CO2 emissions				MtCO2													
48	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		Oil, Natural Gas, Coal, Flaring, & Cement				Mt Carbon													
49	CDIAC sums December 2019																																			
50	4.56%	4.48%	4.29%	4.19%	4.02%	3.92%	3.38%	3.53%	3.45%	3.25%	3.33%	3.06%	2.92%	2.94%	3.22%	3.41%	2.24%		Entity percent of total CO2 emissions				Percent													
51																																				
52																																				
53																																				
54	88.0	91.7	94.7	98.4	99.5	101.2	99.9	105.1	109.5	113.4	115.2	118.2	117.8	118.4	120.0	122.7	6,971		CDIAC/EDGAR methane				Tg CH4													
55																					-		Entity percent of total CH4 emissions				Percent				Percent					
56	11.74%	11.54%	11.17%	10.77%	10.51%	10.35%	8.83%	9.24%	8.95%	8.22%	8.16%	7.27%	6.90%	6.89%	7.61%	8.24%	4.40%		Entity percent of total CH4 emissions				Percent													
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Gazprom

Cell: FY48

Comment: Rick Heede:

CAI compares entity emissions to the CDIAC / Global Carbon Project (www.globalcarbonproject.org) annual estimate of carbon dioxide emissions from fossil fuels and cement production. The CAI Carbon Majors methodology is based on the CDIAC methodology; 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 Metz, David R. Munro, Julia E. M. S. Nabel, Shin-Ichiro Nakaoka, Craig Neill, Abdirahman M. Omar, Tsunee Ono, Anna Peregon, Denis Pierrot, Benjamin Poulter, Gregor Rehder, Laure Resplandy, Eddy Robertson, Christian Rödenbeck, Roland Séférian, Jörg Schwingner, Naomi Smith, Pieter P. Tans, Hanqin Tian, Bronte Tilbrook, Francesco N Tubiello, Guido R. van der Werf, Andrew J. Wiltshire, Sönke Zaehele. 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.

Cell: FY54

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). CAI uses revised data from EDGAR for 1970-2015, with extrapolation by CAI for 2016-2018 (based on growth of emissions from oil, gas, and coal production). There is a non-linearity at 1969/1970 btw datasets.
Methane emissions may be revised if a more comprehensive and integrated dataset becomes available.
Furthermore, the Stern & Kaufman does not estimate methane emissions from oil (only gas-related CH4). The most recent EDGAR Nov19 datasets aggregate methane emissions from the Oil & Gas sector. CAI disaggregates methane from oil and methane from gas on the basis of an earlier EDGAR dataset 1970-2008 that reports CH4 from oil and gas separately. CAI uses this average allocation of ~695% from gas and ~30.5% from oil to estimate methane emissions from both sectors. This, given the fluctuations of methane emissions --the proportion from natural gas increases over time (from 50% in 1970 to 76% in 2008) -- this disaggregation is only approximate.

Stern, David I., & Robert K. Kaufmann (1998) "Annual Estimates of Global Anthropogenic Methane Emissions: 1860-1994," in Trends Online: A Compendium of Data on Global Change, Carbon Dioxide Information Analysis Center, Oak Ridge National Lab., U.S. DOE, Oak Ridge, Tenn., U.S.A. <http://cdiac.esd.ornl.gov/trends/meth/ch4.htm#flaring>

Crippa, M., G. Oreggioni, D. Guizzardi, M. Muntean, E. Schaaf, E. Lo Vullo, E. Solazzo, F. Monforti-Ferrario, J.G.J. Olivier, & E. Vignati (2019) Fossil CO2 and GHG emissions of all world countries - 2019 Report, Publications Office of the European Union, Luxembourg. ISBN 978-92-76-11100-9. https://edgar.jrc.ec.europa.eu/overview.php?VP_GHG