

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

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	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				
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9																																						
10	2000s																		2010s											Cumulative								
11	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	MtCO2e	Entity emissions														Cumulative	Cumulative	Cumulative	Cumulative		
12																			(except where noted)	(V = verified)														(except where noted)	(except where noted)	(except where noted)	(except where noted)	
13																				Entity CO2 emissions														kg CO2/tCO2	to 2015	to 2016	to 2017	to 2018
14																																						
15																				Oil & NGLs														linked				
16																				Natural Gas														linked				
17	582	617	649	682	726	775	775	784	813	831	889	969	996	1,020	1,091		21,870	Coal														linked	18,763	19,759	20,779	21,870		
18	582	617	649	682	726	775	775	784	813	831	889	969	996	1,020	1,091		21,870	Combustion total														sum	18,763	19,759	20,779	21,870		
19																																						
20																				Oil & NGLs: Venting														calculated	3.83			
21																				Oil & NGLs: Flaring														linked	15.94			
22																				Own fuel use														calculated	57.26			
23																				Natural Gas: Venting														calculated	28.53			
24																				Natural Gas: Flaring														calculated	1.74			
25																				Venting & Flaring total														sum				
26																																						
27																				Cement														linked				
28																																						
29	582	617	649	682	726	775	775	784	813	831	889	969	996	1,020	1,091		21,870	Total CO2 emissions														sum	row 18+24+26	18,763	19,759	20,779	21,870	
30																																						
31																																						
32																				Entity methane emissions														kg CH4/tCO2	to 2015	to 2016	to 2017	to 2018
33																				Methane: Oil & NGLs														calculated	1.92			
34																				Methane: Natural Gas														calculated	9.88			
35	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4		88	Methane: Coal														calculated	4.03					
36	2	2	3	3	3	3	3	3	3	3	4	4	4	4	4		88	Total methane emissions														sum	76	80	84	88		
37																																						
38																																						
39																				Entity methane emissions														GWP	to 2015	to 2016	to 2017	to 2018
40																				Methane: Oil & NGLs														calculated	28			
41																				Methane: Natural Gas														calculated	28			
42	66	70	73	77	82	88	88	89	92	94	100	109	113	115	123		2,471	Methane: Coal														calculated	28					
43	66	70	73	77	82	88	88	89	92	94	100	109	113	115	123		2,471	Total methane emissions														sum	per IPCC SAR	2,120	2,232	2,347	2,471	
44																																						
45	647	687	722	759	808	863	863	872	905	925	989	1,078	1,109	1,135	1,214		24,341	Total attributed emissions														sum	20,882	21,991	23,126	24,341		
46																																						
47																																						
48	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	1,505,476	1,540,727	1,576,408	1,612,851		
49	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						
50																				CDIAC sums December 2019																		
51	2.05%	2.11%	2.15%	2.19%	2.28%	2.47%	2.35%	2.30%	2.35%	2.39%	2.53%	2.76%	2.83%	2.86%	2.99%		1.36%	Entity percent of total CO2 emissions														Percent	1.25%	1.28%	1.32%	1.36%		
52																																						
53																																						
54	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	6,610	6,728	6,848	6,971		
55																																						
56	2.56%	2.63%	2.66%	2.77%	2.89%	3.13%	2.98%	2.89%	2.89%	2.91%	3.03%	3.32%	3.39%	3.43%	3.59%		1.27%	Entity percent of total CH4 emissions														Percent	1.15%	1.18%	1.22%	1.27%		
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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 Quééré, 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 Gillilan, 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 Liener, 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 Schwinger, Naomi Smith, Pieter P. Tans, Hanqin Tian, Bronte Tilbrook, Francesco N Tubiello, Guido R. van der Werf, Andrew J. Wiltshire, Sonke Zaehle. Global Carbon Budget 2019, Earth Syst. Sci. Data, 2019. <https://doi.org/10.5194/essd-11-1783-2019>

See also: Gillilan, 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