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38,299	CDIAC cement emissions (Million tonnes of CO2) 1929-2013																																																																																																																																																																																																																																																																																																												
10,452	CDIAC cement emissions (Million tonnes of carbon)																																																																																																																																																																																																																																																																																																												
44.9%	Percent of cumulative CDIAC cement emissions																																																																																																																																																																																																																																																																																																												
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<p>** CMS has collected data from company CSR reports on gross CO2 emissions on each entity's emissions from both process emissions (calcining limestone) and thermal + electric input emissions. ("Gross cement emissions" worksheet.) In order to estimate process emissions only (to exclude each entity's fossil fuel emissions), CMS uses WBCSD's CSI data on average industry process emissions as a percent of gross CO2 emissions for 1990, 2000, 2005, and 2006. This percentage (in row 12: interpolated between CSI data years, extrapolating to 2008, and assuming pre-1990 equal to 1990) is applied to each entity's gross CO2 emissions from cement manufacturing (previous worksheet).</p>																																																																																																																																																																																																																																																																																																													

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Comment: Rick Heede:

CMS lists the IPCC 1996 Guideline factor of EF clinker = $0.646 \cdot 0.785 = 0.5071$ tCO₂ per tonne of clinker produced.
(Average clinker lime percentage of 64.6 percent; molecular weight ratio of CO₂/CaO = 78.5 percent.)

Cell: CT4

Comment: Rick Heede:

To quote from Boden et al (1995): "This conversion factor was obtained by dividing the molar mass of carbon by the molar mass of calcium oxide and multiplying this quotient by the average fraction of calcium oxide contained in cement: (12.01 g C/mole CaCO₃ + 56.08 g CaO /mole CaCO₃) * 0.635 g CaO /g cement = 0.136 g C /g cement."
"The consensus that 63.5% of the typical cement in the world is composed of calcium oxide is based on the opinions of experts consulted in the field, as well as inspection of composition data by type and country (Griffin 1987)."
CMS: The formula: $(12.01/56.08) \cdot 0.635 \cdot 3.667 = 0.4987$, rounded up to 0.500.
CDIAC (1995) Estimates of Global, Regional, and National Annual CO₂ Emissions from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring: 1950-1992, by T. A., Boden, G. Marland, & R. J. Andres. cdiac.ornl.gov/epubs/ndp/ndp030/ndp0301.htm#co2man

Cell: CT6

Comment: Rick Heede (Mar10):

WBCSD's Cement Sustainability Initiative reports average global gross emissions per tonne of clinker produced at 866 kg CO₂ per tonne (declining from 914 kg CO₂/tonne in 1990. See rpt for geographic, process (wet vs dry), or temporal variables, and entity reporting by region. Process emissions from calcining limestone into clinker is typically 540 kg CO₂ per tonne of clinker.
WBCSD, Cement Sustainability Initiative (2009) Cement Industry Energy and CO₂ Performance "Getting the Numbers Right", World Business Council for Sustainable Development, 44 pp., www.wbcscement.org

Cell: CT8

Comment: Rick Heede:

WBCSD Cement Sustainability Initiative (2009) Cement Industry Energy and CO₂ Performance "Getting the Numbers Right", World Business Council for Sustainable Development, 44 pp., wbcscement.org.
Page 30:
(1) about 60% of gross CO₂ emissions originate from limestone decomposition
(2) 40% are fuel emissions where, apart from energy efficiency, the fuel composition plays a role.
In Figure 6.4: Gross CO₂ emissions per tonne of clinker, 2006: GNR global average 866 kg CO₂ per tonne of clinker.
CMS: Thus 60 percent of 866 kgCO₂/t = 519.6 kg CO₂/tonne.

Cell: CT11

Comment: Rick Heede:

IPCC (2006) Guidelines, Vol. 3, Chapter 2, Section 2.2.1.2 Choice of Emission Factors, Tier 1 Method, page 2.11.
"For the default CaO composition, 1 tonne of clinker contains 0.65 tonnes CaO from CaCO₃. This carbonate is 56.03 percent CaO and 43.97 percent CO₂ by weight (Table 2.1). The amount (X) of CaCO₃ needed to yield 0.65 tonnes CaO is: $X = 0.65/0.5603 = 1.1601$ tonnes CaCO₃ (unrounded). The amount of CO₂ released by calcining this CaCO₃ = $1.1601 \cdot 0.4397 = 0.5101$ tonnes CO₂ (unrounded). Assuming a correction addition of 2 percent to account for CKD, the rounded default emission factor (EF_{cl}) for clinker is 0.52 tCO₂/tonne of clinker."
Intergovernmental Panel on Climate Change (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 3: Industrial Processes and Product Use, Chapter 2: Mineral Industry Emissions, www.ipcc-nggip.iges.or.jp/public/2006glvol3.html

Cell: CT13

Comment: Rick Heede:

Note: CMS compared carbon emissions from world cement production using USGS production data 1926-2010 results in estimates ~3.8 percent higher than cement emission estimates by CDIAC (based on both totals 1950-2010).
Correcting the Carbon Majors calculations to that of CDIAC suggests a process emission factor of 519.6 - $(519.6 \cdot 0.00377) = 499.86$ kg CO₂/tonne.
CDIAC (1995) Estimates of Global, Regional, and National Annual CO₂ Emissions from Fossil-Fuel Burning, Hydraulic Cement Production, and Gas Flaring: 1950-1992, by T. A., Boden, G. Marland, & R. J. Andres. cdiac.ornl.gov/epubs/ndp/ndp030/ndp0301.htm#co2man

Cell: CT18

Comment: Rick Heede:

* CMS has collected data from company CSR reports on net CO₂ emissions on each entity's emissions from both process emissions (calcining limestone) and thermal + electric input emissions. ("Net cement emissions" worksheet.)
In order to estimate process emissions only (to exclude each entity's fossil fuel emissions), CMS uses WBCSD's CSI data on average industry process emissions as a percent of net CO₂ emissions for 1990, 2000, and 2005-2013.
This percentage (in row 12) is applied to each entity's net CO₂ emissions from cement manufacturing (previous worksheet).
This percentage data series is derived in the Cement.xls workbook / "Cement industry data", Table 3, row "AB".

Cell: CT23

Comment: Rick Heede:

CMS uses CDIAC emissions from cement production in China 1929-2010.

Cell: CT40

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: $C=12.0107 + O=15.9994 \times 2 = 44.0095/12.0107 = 3.664191$.

Cell: CT42

Comment: Rick Heede:

From the associated "Methods" paper: CDIAC's emissions methodology is not described.

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 10.33334/CDIAC/00001.

Dec11: CMS added CDIAC extrapolations for gas emissions from their dataset "Preliminary 2009-2010 Global & National Estimates by Extrapolation" (undated) to the main file cited above.

November 2014: Global Carbon Budget, Fossil fuel and Cement emissions data for 2011-2013.

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Comment: Rick Heede:

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Comment: Rick Heede:

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