



## DOCUMENTATION OF CALIFORNIA'S GREENHOUSE GAS INVENTORY

Last reviewed on May 21, 2009 at 15:20

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### ? Category: Waste

**IPCC:** 4D1 - Wastewater Treatment and Discharge - Domestic Wastewater Treatment and Discharge

**Sector:** Industrial : Wastewater Treatment : Domestic Wastewater : Centralized Anaerobic

### ? Greenhouse gas: Methane ( CH<sub>4</sub> )

#### ? 2006 CH<sub>4</sub> from California population - —

(Version 2 - Last updated on 03/13/2009)

#### ? GREENHOUSE GAS EMISSION ESTIMATE —

**Amount:** 19,479 tonnes of CH<sub>4</sub> Emitted (409,065 tonnes CO<sub>2</sub> Eq.)

**Basis:** Calculation

**Calculation:** [California Population] \* [Per Capita biological organic demand (BOD<sub>5</sub>)] \* [Average number of days per year] \* [Proportion centrally treated] \* [Proportion anaerobic] \* (([Proportion anaerobic without primary treatment] + ([Proportion anaerobic with primary treatment] \* (1 - [Proportion of BOD removed in primary treatment]))) \* [Maximum methane production capacity] \* [Methane correction factor for anaerobic systems]

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

#### ? ACTIVITY LEVEL USED IN CALCULATIONS —

**Activity:** California population = 37,332,976 person

**Basis:** Data

**Reference:** CDOF (2008). California Department of Finance, California Demographic Research Unit: Population Estimates and Projections. Accessed online at: <http://www.dof.ca.gov/HTML/DEMOGRAP/ReportsPapers/ReportsPapers.php>

#### ? PARAMETERS AND CONSTANTS USED IN CALCULATIONS —

**Parameter:** Digester gas production rate = 1 cf / person / day

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Maximum methane production capacity = 0.6 g / g

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Methane correction factor for anaerobic systems = 0.8

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Methane correction factor for septic systems = 0.5

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Methane correction for aerobic not well managed = 0.3

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Methane destruction efficiency = 0.99

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Per capita biological organic demand (BOD5) = 90 g / day

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Per capita wastewater flow = 100 gal / person / day

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion aerobic = 0.953

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion aerobic with primary treatment = 0.819

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion aerobic without primary treatment = 0.182

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion anaerobic = 0.047

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion anaerobic with primary treatment = 0.671

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion anaerobic without primary treatment = 0.329

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion centrally treated = 0.9

**Reference:** CWTRC, 2003. Status Report: Onsite Wastewater Treatment Systems in California. Jointly presented by: California Wastewater Training & Research Center, California State University Chico and USEPA Region 9 Ground Water Office. August 2003. <http://www.csuchico.edu/cwtrc/Pages/InfoandReoprtspage.htm>

**Parameter:** Proportion in septic systems = 0.1

**Reference:** CWTRC, 2003. Status Report: Onsite Wastewater Treatment Systems in California. Jointly presented by: California Wastewater Training & Research Center, California State University Chico and USEPA Region 9 Ground Water Office. August 2003. <http://www.csuchico.edu/cwtrc/Pages/InfoandReoprtspage.htm>

**Parameter:** Proportion of BOD removed in primary treatment = 0.325

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion of CH4 in biogas = 0.65

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Proportion of operations not well managed = 0

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. [http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Parameter:** Wastewater flow to plants with anaerobic digesters = 17,926,500,000 gal / day

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. EPA 430-R-08-005. Chapter 8: Waste. April 15, 2008. Washington DC. ARB staff scaled USEPA's national data down to California pro-rata to yearly population estimates.  
[http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Constant:** Average number of days per year = 365.2425 day

**Reference:** USNO (2004). U.S. Naval Observatory, Astronomical Applications Department, Leap Years. Accessed online at: [http://aa.usno.navy.mil/faq/docs/leap\\_years.php](http://aa.usno.navy.mil/faq/docs/leap_years.php)

**Constant:** Methane density = 662 g / m<sup>3</sup>

**Reference:** USEPA (2008). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. United States Environmental Protection Agency. USEPA 430-R-08-005. Annex 3.10: Methodology for Estimating CH<sub>4</sub> and N<sub>2</sub>O Emissions from Manure Management. April 15, 2008. Washington DC.  
[http://www.epa.gov/climatechange/emissions/usgginv\\_archive.html](http://www.epa.gov/climatechange/emissions/usgginv_archive.html)

**Constant:** Global warming potential of CH<sub>4</sub> = 21

**Reference:** IPCC (1996). Second Assessment Report. Climate Change 1995: WG I - The Science of Climate Change. Intergovernmental Panel on Climate Change; J.T. Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg, and K. Maskell (eds.); Cambridge University Press. Cambridge, U.K.

#### ? GREENHOUSE GAS EMITTED PER UNIT ACTIVITY —

**Amount:** 522 g of CH<sub>4</sub> per person

10,957 g (i.e. 10.96 kg) of CO<sub>2</sub>eq. per person

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