MINERALS SECTOR

All emissions presented here are as of 9/1/2013 and exclude biogenic CO_2.

Highlights

- Emissions from the Minerals Sector were 107.5 million metric tons of carbon dioxide equivalent (MMT CO_2e) in 2012 from 369 facilities. The largest emitting subsector was cement production, which emitted two times more CO_2e than the next largest subsector (lime manufacturing).
- Emissions from this sector increased by about six percent from 2010 to 2012, due primarily to an increase in reported emissions in the cement production subsector.
- Eighty four percent of the cement industry is now using CO_2 Continuous Emissions Monitoring System (CEMS) technology, up from 46% in 2010.

About this Sector

The minerals sector consists of cement production, glass manufacturing, lime manufacturing, soda ash production, and any other mineral production facility operating under NAICS codes beginning with 327 (Nonmetallic Mineral Product Manufacturing). Facilities under this sector transform mined or quarried nonmetallic minerals, such as sand, gravel, stone, clay, and refractory materials, into products for intermediate or final consumption. Glass, cement, and lime manufacturing facilities report both process emissions from the calcination of carbonate-based raw materials and GHG emissions from stationary combustion sources. The other mineral production subsector comprises facilities that report GHG emissions only from stationary fuel combustion sources. A small number of facilities in this sector collect CO_2 either for use in their other production processes (e.g. sugar refining), to transfer to other users, or to sequester or otherwise inject underground. Process emissions reported under this sector include this CO_2.

Who Reports?

For 2012, 369 facilities in the Minerals Sector reported emissions of 107.5 million metric tons CO_2e (MMT CO_2e). The Minerals Sector represents five percent of the facilities reporting direct emissions to the GHGRP and about two percent of total U.S. GHG emissions[a].

Table 1: Minerals Sector Reporting Schedule by Subpart

Subpart	Source Category	Applicability	First Reporting Year
H	Cement Production	All facilities	2010
N	Glass Production	Facilities emitting ≥ 25,000 metric tons CO_2e/year	2010
S	Lime Manufacturing	All facilities	2010
CC	Soda Ash Production	All facilities	2010
C	Other Minerals	Facilities under NAICS codes beginning with 327 (nonmetallic mineral product manufacturing) that emit ≥ 25,000 metric tons CO_2e/year from stationary fuel combustion	2010

[a] The total U.S. GHG emissions are 6,525.6 MMT CO_2e as reported in the Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2012. U.S. Environmental Protection Agency. April 15, 2014. EPA 430-R-14-003. Available at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2012.

Table 2: Minerals Sector – Number of Reporters (2010–2012)[a]

Source Category	Number of Reporters		
	2010	2011	2012
Total Minerals Sector	**359**	**367**	**369**
Cement Production	98	96	96
Glass Production	110	111	107
Lime Manufacturing	71	74	74
Soda Ash Production	4	4	4
Other Minerals	77	83	89

[a] The total number of reporters is less than a sum of the number of reporters in each individual source category because some facilities contain more than one source category.

Table 3: Minerals Sector – GHGRP Coverage

Source Category	GHGRP Coverage of Industry	Estimated Percent of Industry Facilities Covered by GHGRP	Estimated Percent of Industry Emissions Covered by GHGRP
Cement Production	All facilities	100%	100%
Lime Manufacturing	All facilities	100%	100%
Glass Production	Facilities emitting ≥ 25,000 metric tons CO_2e/year	29%[a]	61% - 86%[b]
Soda Ash Production	All facilities	100%	100%
Other Minerals	Facilities emitting ≥ 25,000 metric tons CO_2e/year	N/A[c]	N/A[c]

[a] Estimate of size of industry based on the draft Glass Plant Database[b] and the GHGRP. According to the draft Glass Plant Database, there are 374 glass production facilities in the United States. According to the GHGRP, there are 110 glass production facilities in the United States that emit greater than or equal to 25,000 metric tons CO_2e per year. This leaves 264 glass production facilities in the United Sates that emit less than 25,000 MT CO_2e. The estimated GHGRP coverage is 29% of the glass production facilities in the United States.

[b] Estimate of overall industry emissions based on the draft Glass Plant Database[2] and the GHGRP. In order to estimate the amount of coverage for CO_2e emissions from the glass production industry, an average emission value for each of the 264 facilities not covered by the GHGRP was assumed. Using average emissions of 5,000 metric tons CO_2e per year and 20,000 metric tons CO_2e per year, the total emissions from these 264 facilities range from 1.3 MMT to 5.3 MMT. Using the emissions total of 8.2 MMT from the GHGRP, GHGRP emissions coverage ranges from 61% to 86% of the total glass production industry.

[c] Due to the diversity of facilities and products within the Other Minerals subsector, the U.S. population of all facilities similar to this subsector of GHGRP reporters is not available. However, fuel and feedstock data for 2010 (available from EIA's MECS data publication at http://www.eia.gov/consumption/manufacturing/about.cfm) indicate that approximately 90% of GHG emitting feedstocks and fuels reported to EIA under NAICS code 327 (Nonmetallic Mineral Products) were reported to the GHGRP in 2010.

[b] United States Glass Plant Database. U.S. Environmental Protection Agency, Washington D.C. 2006.

Reported Emissions

All GHG emissions data, displayed in units of carbon dioxide equivalent (CO_2e) reflect the global warming potential (GWP) values from the Intergovernmental Panel on Climate Change, Climate Change 1995: The Science of Climate Change (Second Assessment Report (SAR), Cambridge, United Kingdom: Cambridge University Press). The SAR values also can be found in the version of Table A-1 to 40 CFR part 98 that was published on October 30, 2009 (74 FR 56395).

Table 4: Minerals Sector Emissions by Subsector (2010–2012)

Minerals Sector	Emissions (MMT CO_2e)		
	2010	2011	2012
Total Minerals Sector[a]	**101.1**	**103.2**	**107.5**
Cement Production	55.4	55.5	60.0
Glass Production	8.1	8.4	8.2
Lime Manufacturing	29.1	30.6	30.3
Soda Ash Production	5.1	5.1	5.2
Other Minerals	3.4	3.6	3.8

[a] Represents total emissions reported to the GHGRP from this industry. Additional emissions may occur at facilities that have not reported; for example, those below the reporting threshold.

Figure 1: Minerals Sector – Emissions by Subsector (2012)

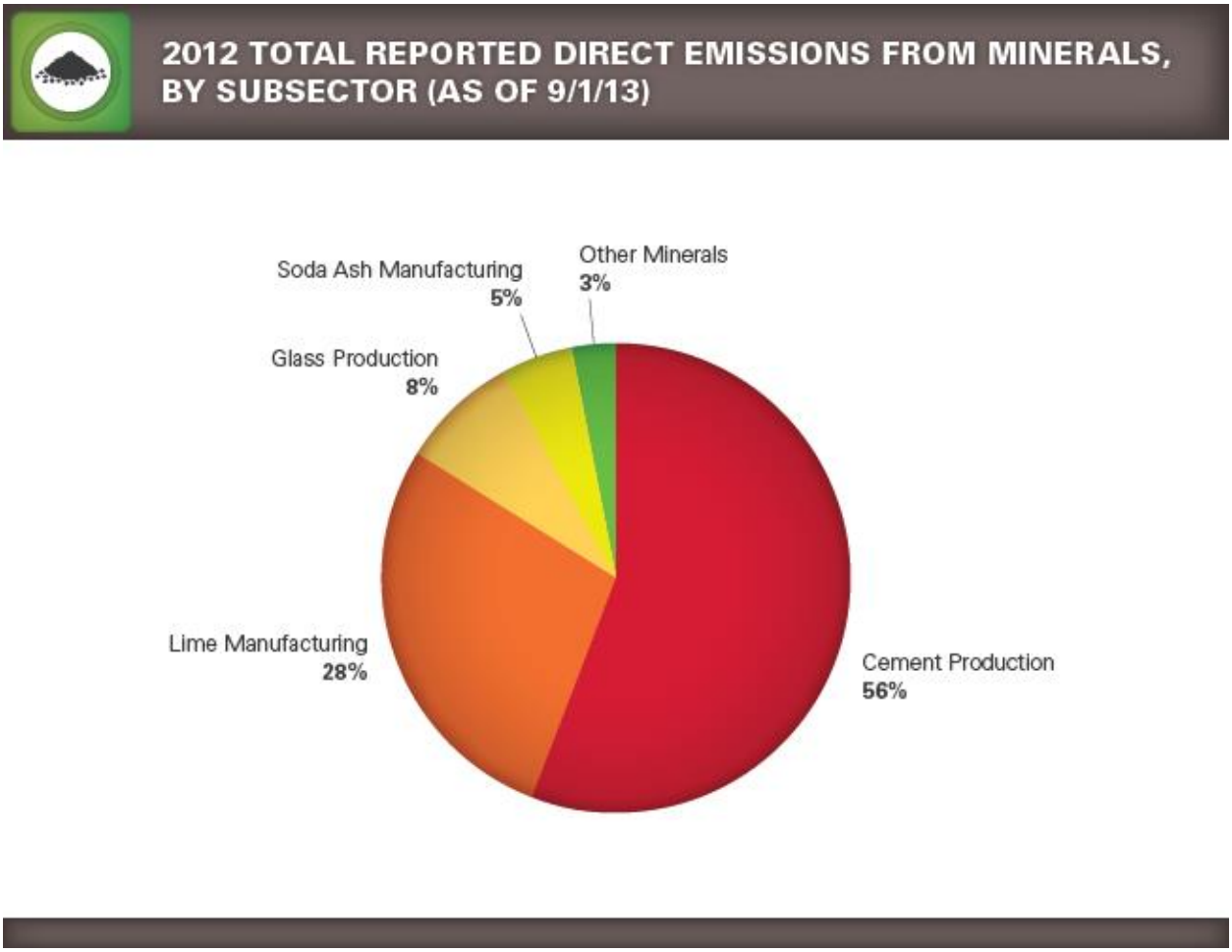

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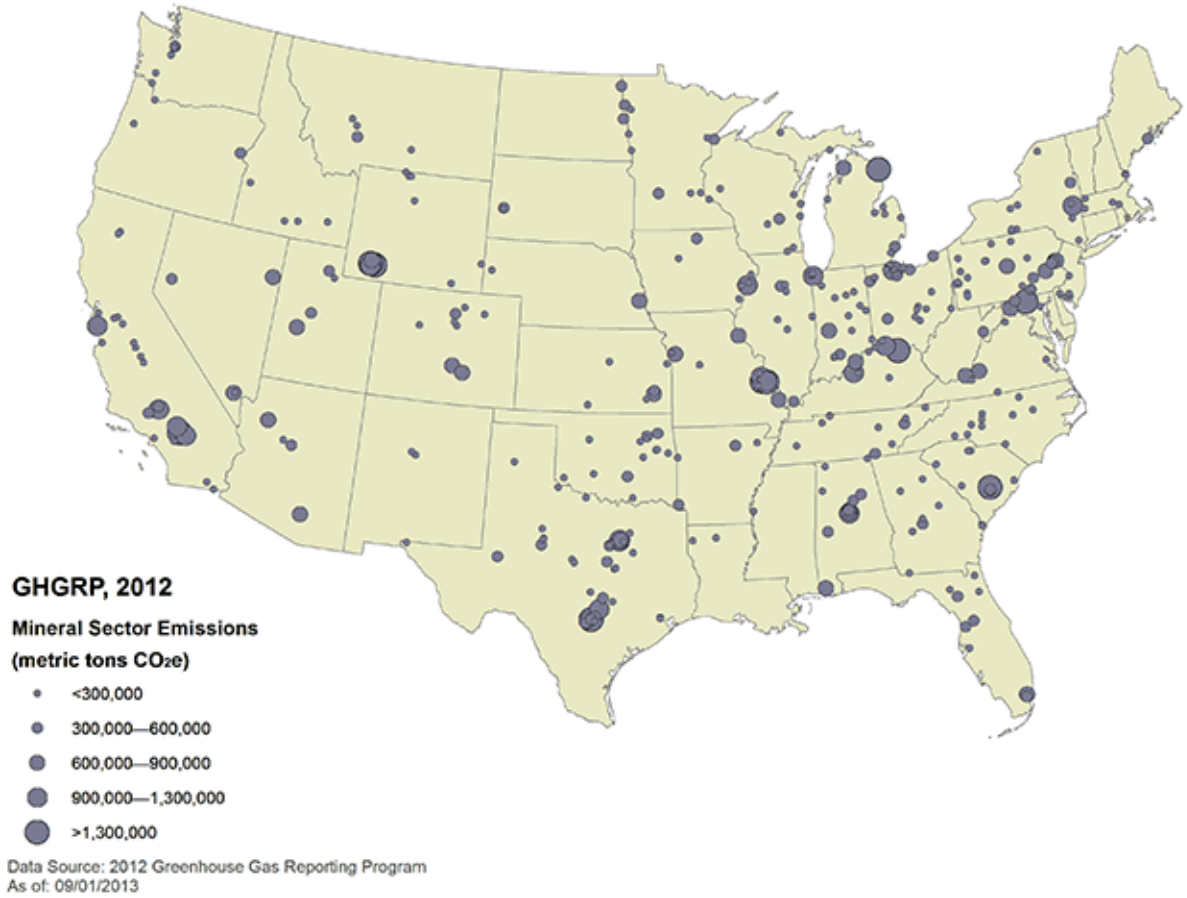
Figure 2: Location and Emissions Range for Each Reporting Facility in the Minerals Sector (as of 9/1/13)

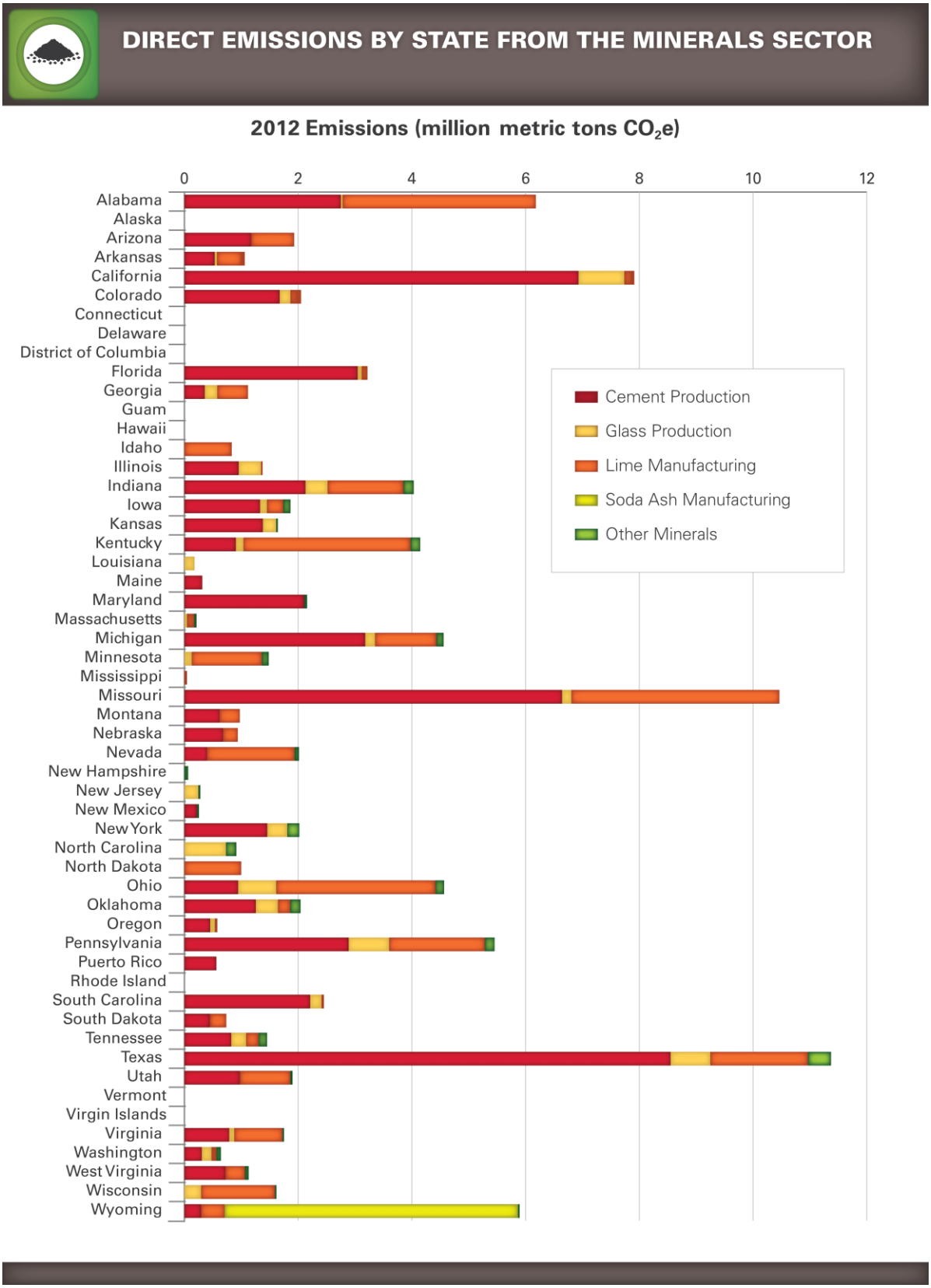


This map shows the locations of direct-emitting facilities. The size of a circle corresponds to the quantity of emissions reported by that facility. There are also Minerals Sector facilities located in Puerto Rico (https://www.epa.gov/ghgreporting/ghgrp-minerals).

Readers can identify the largest emitting facilities by visiting the Facility Level Information on GreenHouse Gases Tool (FLIGHT) website (http://ghgdata.epa.gov).

Facilities in the Minerals Sector are not highly concentrated geographically. Mineral facilities are located in 43 states and Puerto Rico. The only subsector with emissions concentrated in one area is Soda Ash production, where all four reporting facilities are located in Wyoming.

Figure 3: Minerals Sector – Emissions by State (2012)[a]



[a] Represents total emissions reported to the GHGRP from this industry. Additional emissions occur at facilities that have not reported, for example those below the reporting threshold.

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Minerals Sector Emissions Trends 2010 to 2011

Mineral sector emissions were 2.1 MMT CO_2e higher in 2011 than 2010 (two percent increase). Emissions from the Lime Manufacturing subsector increased by 1.5 MMT CO_2e, representing the majority of the increase. The increase was likely due to an increase in the amount of lime produced and an increase in the number of reporters. According to data from the USGS[c], total U.S. lime production increased from 18.3 to 19.1 million metric tons from 2010 to 2011. Emissions increased slightly for cement, glass, and other minerals. The number of reporters dropped slightly for cement and increased slightly for lime, glass, and other minerals, resulting in an overall increase of eight reporters.

About 60-70% of the emissions for the sector are process emissions. The 2011 data showed a 10 percent shift in the source of emissions from combustion to process emissions. The likely cause is that a number of cement facilities began using CEMS for the first time in 2011. For these facilities, a CEMS measures both combustion and process emissions. The rule specifies to report CEMS emissions as process emissions for these sources. Therefore, the reported shift is likely due to the change in monitoring method and not due to significant changes in fuel use or process operation.

Minerals Sector Emissions Trends 2011 to 2012

Mineral sector emissions were 4.3 MMT CO_2e higher in 2012 than 2011 (a four percent increase). Emissions from the Cement Production subsector increased by 4.5 MMT CO_2e, according to data from the USGS[d], total U.S. cement production increased from 67.9 to 73.0 million metric tons from 2010 to 2011. The use of CEMS in the cement subsector was not significantly different in 2012 compared to 2011. Emissions were slightly less in 2012 than 2011 for glass and lime. Soda ash and other minerals saw a slight increase in emissions. The number of reporters dropped slightly for glass and increased slightly for other minerals, resulting in an overall increase of two reporters.

[c] USGS (January 2013). 2013 Mineral Commodity Summary: Lime. http://minerals.usgs.gov/minerals/pubs/commodity/lime/mcs-2013-lime.pdf.

[d] USGS (January 2013). 2013 Mineral Commodity Summary: Cement. http://minerals.usgs.gov/minerals/pubs/commodity/cement/mcs-2013-cemen.pdf.

Figure 4: Minerals Sector – Emissions Trend (2010-2012)

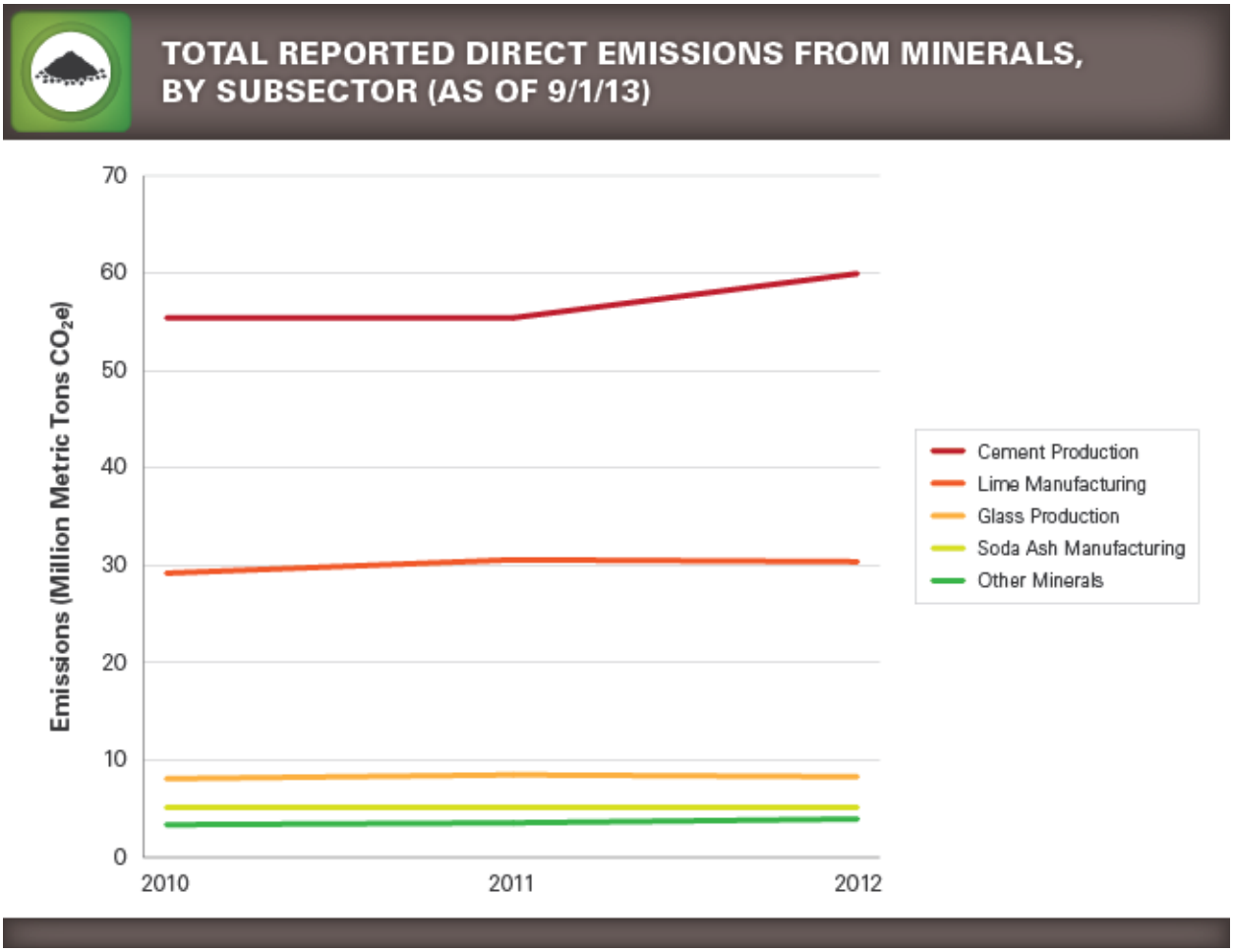

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Table 5: Minerals Sector — Emissions by GHG (MMT CO_2e)[a]

MCS Sector	Reporting Year		
	2010	**2011**	**2012**
Number of facilities	359	367	369
Total emissions (MMT CO_2e)	101.1	103.2	107.5
Emissions by GHG			
Carbon dioxide (CO_2)			
• Cement Production	55.2	55.3	59.8
• Glass Production	8.1	8.4	8.2
• Lime Manufacturing	28.9	30.5	30.2
• Soda Ash Production	5.1	5.1	5.1
• Other Minerals	3.4	3.6	3.8

MCS Sector	Reporting Year		
	2010	2011	2012
Methane (CH_4)			
• Cement Production	0.1	0.1	0.1
• Glass Production	**	**	**
• Lime Manufacturing	**	**	**
• Soda Ash Production	**	**	**
• Other Minerals	**	**	**
Nitrous oxide (N_2O)			
• Cement Production	0.1	0.1	0.1
• Glass Production	**	**	**
• Lime Manufacturing	0.2	0.1	0.1
• Soda Ash Production	**	**	**
• Other Minerals	**	**	**

[a] Represents total emissions reported to the GHGRP in this industry sector. Additional emissions may occur at facilities that have not reported, for example those below the 25,000 metric ton CO_2e reporting threshold

[b] Totals may not sum due to independent rounding.

** Total reported emissions are less than 0.05 MMT CO_2e.

Carbon dioxide constitutes more than 99% of GHG emissions from all minerals production subsectors.

Figure 5: Minerals Sector – Average Emissions per Reporter (2012)

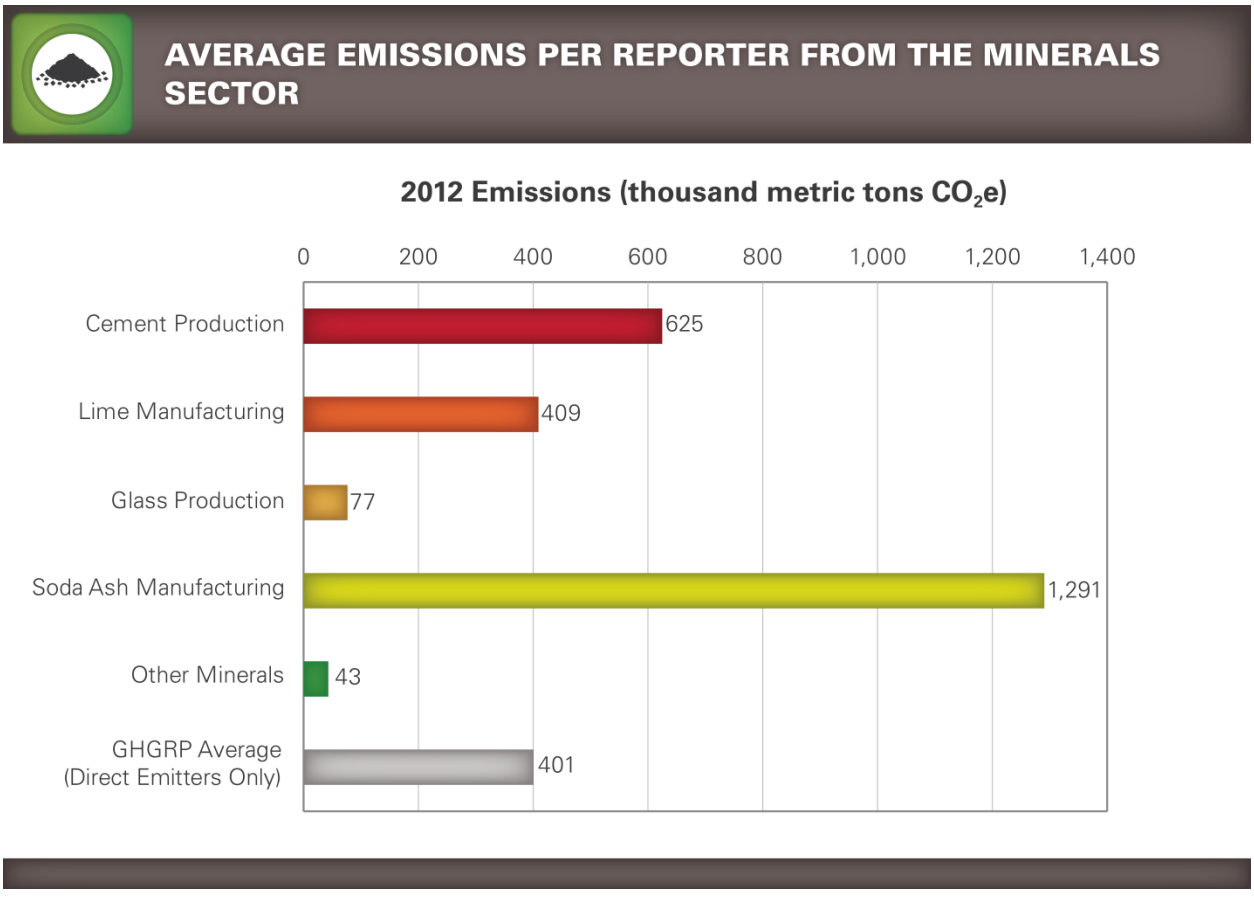
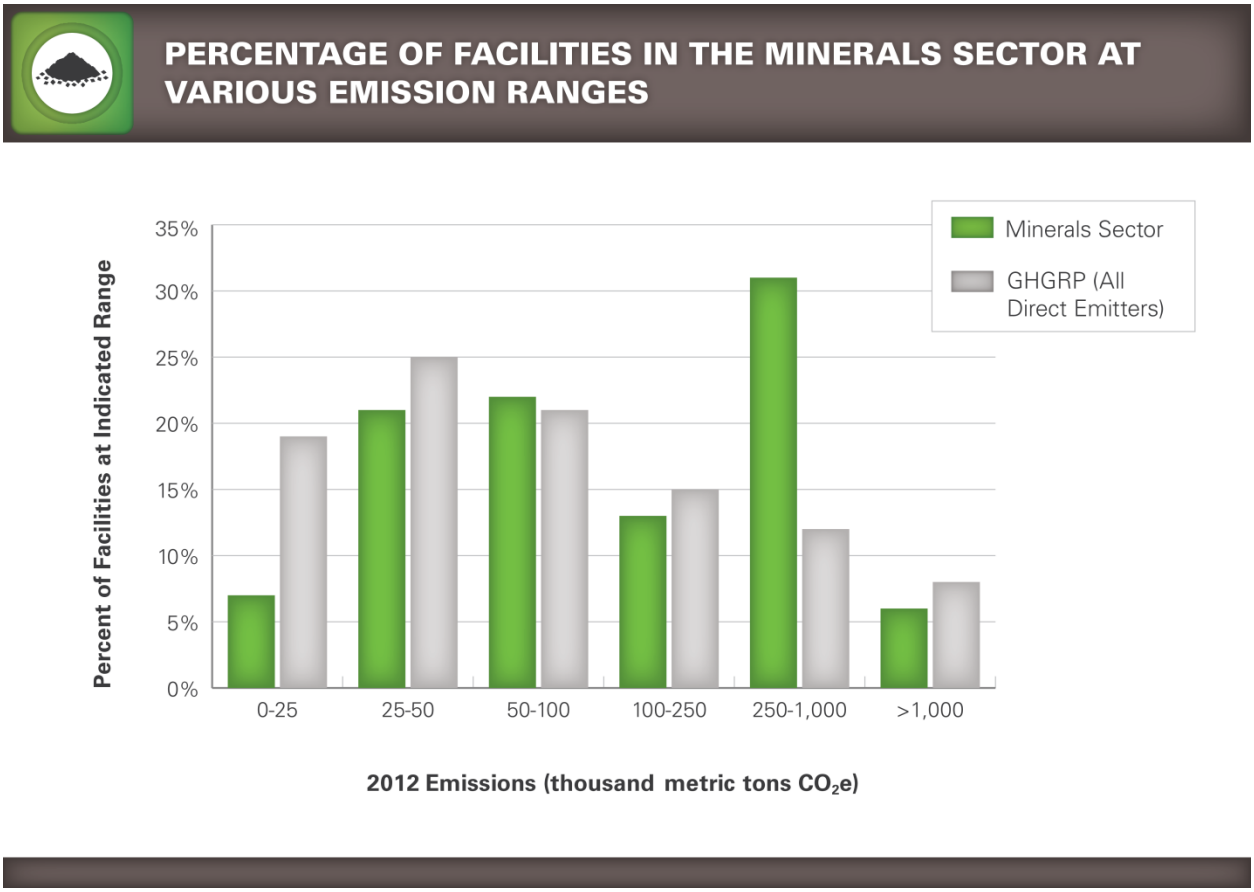


Table 6: Minerals Sector – Number of Reporters by Range of Emissions (2012)

Minerals Sector	< 0 - 0.025	0.025 - 0.05	0.05 - 0.1	0.1 - 0.25	0.25 - 1	> 1
Total Minerals Sector	**26**	**78[a]**	**81**	**47**	**115**	**22**
Cement Production	2		2	7	72	13
Glass Production	4	31	49	23		
Lime Manufacturing	1	3	6	17	41	6
Soda Ash Production					1	3
Other Minerals	19	45	24		1	

[a] Totals will not sum because one facility reports under both Soda Ash Production and Lime Manufacturing.

Figure 6: Percentage of Reporters by Range of Emissions (2012)



Calculation Methods Used

The production of mineral products results in both process-related emissions (CO_2 from the volatilization of carbonaceous raw materials in kilns and furnaces) and fuel combustion emissions (CO_2, CH_4, and N_2O from the burning of fuel in kilns and furnaces to produce heat).

Facilities must calculate GHG emissions using one of the following methods:

- **Process emissions**
  - **CEMS –** Operate a CEMS to measure CO_2 emissions according to requirements specified in 40 CFR part 98, subpart C (does not apply to the soda ash subsector).
  - **Carbon mass balance –** Calculate process CO_2 emissions based on measurements of the annual mass of process inputs or outputs or both (depending on the subsector), and periodic analyses of the weight fraction of carbon in inputs and outputs.
- **Fuel combustion emissions –** Follow the applicable tier method prescribed in subpart C (general stationary fuel combustion sources) to estimate CO_2 emissions (Tier methods are shown in Tables 7 – 11). All facilities use default emission factor to estimate CH_4 and N_2O emissions from fuel combustion.

Table 7: Cement Production – Methodologies

Type of Emissions	Methodology	Percentage of Emissions Monitored by Method (by Type)		
		2010	2011	2012
Process	CEMS[a]	58.2%	94.1%	95.5%
	Mass balance	41.8%	5.9%	4.5%
Combustion	CEMS (Tier 4)	0%	0.1%	0%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	53.7%	45.6%	36.2%
	Measured high heating values (HHVs) and default emission factors (Tier 2)	40.5%	31.1%	40.7%
	Default HHVs and emission factors (Tier 1)	5.7%	23.3%	23.1%
	Sorbent emissions	0.1%	0%	0%

[a] A CEMS monitors the mixture of process and combustion emissions that exit the kiln. When a CEMS is used, the breakdown of emissions between process and combustion emissions is not reported. All emissions monitored with a CEMS are classified as process emissions.

Table 8: Glass Production – Methodologies

Type of Emissions [a]	Methodology	Percentage of Emissions Monitored by Method (by Type)		
		2010	2011	2012
Process	CEMS	0%	1.1%	3.3%
	Mass balance	100%	98.9%	96.7%
Combustion	CEMS (Tier 4)	0%	0.27%	1.1%
	Measured high heating values (HHVs) and default emission factors (Tier 2)	45.5%	46.9%	44.8%
	Default HHVs and emission factors (Tier 1)	54.4%	52.8%	54%
	Sorbent Emissions	**	**	0.1%

[a] At some facilities, process and combustion emissions are combined, emitted through a common stack, and monitored by CEMS. In this circumstance, the breakdown between process and combustion emissions is not reported. In 2010, the quantity of emissions monitored in this way was 0.1 MMT CO_2e. The value was 0.1 MMT CO_2e in 2011 and zero in 2012.

** Value is between 0 and 0.05%.

Table 9: Lime Manufacturing – Methodologies

Type of Emissions	Methodology	Percentage of Emissions Monitored by Method (by Type)		
		2010	2011	2012
Process	CEMS[a]	10.6%	10.7%	10.9%
	Mass balance	89.4%	89.3%	89.1%
Combustion	CEMS (Tier 4)	0%	4.5%	4.7%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	55%	57%	53%
	Measured high heating values (HHVs) and default emission factors (Tier 2)	37.3%	32.6%	34.3%
	Default HHVs and emission factors (Tier 1)	7.8%	5.9%	8%

[a] A CEMS monitors the mixture of process and combustion emissions that exit the kiln. When a CEMS is used, the breakdown of emissions between process and combustion emissions is not reported. All emissions monitored with a CEMS are classified as process emissions.

Table 10: Soda Ash Production – Methodologies

Type of Emissions[a]	Methodology	Percentage of Emissions Monitored by Method (by Type)		
		2010	2011	2012
Process	Mass balance	100%	100%	100%
Combustion	CEMS (Tier 4)	0%	67.7%	66.6%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	65.3%	4.0%	4.0%
	Measured high heating values (HHVs) and default emission factors (Tier 2)	34.4%	28.3%	29.3%
	Default HHVs and emission factors (Tier 1)	**	0%	0%
	Sorbent emissions	0.1%	0%	0%

[a] At some facilities, process and combustion emissions are combined, emitted through a common stack, and monitored by CEMS. In this circumstance, the breakdown between process and combustion emissions is not reported. In 2010, the quantity of emissions monitored in this way was zero. The value was 0.3 MMT CO_2e in 2011 and 0.3 MMT CO_2e in 2012.

** Value is between 0 and 0.05%.

Table 11: Other Minerals – Methodologies

Type of Emissions	Methodology	Percentage of Emissions Monitored by Method (by Type)		
		2010	2011	2012
Combustion	Measured carbon content, and, if applicable, molecular weight (Tier 3)	0%	0%	**
	Measured high heating values (HHVs) and default emission factors (Tier 2)	22.7%	34.5%	31.2%
	Default HHVs and emission factors (Tier 1)	60.8%	65.5%	68.8%
	Abbreviated reporting[a]	16.4%	0%	0%

[a] Abbreviated reporting was only allowed for RY2010. Facilities were eligible to submit an abbreviated report for reporting year 2010 if the only emissions being reported by the facility were stationary fuel combustion sources subject to Subpart C. Facilities that elected to submit abbreviated reports were required to submit only facility-level GHG emissions and were allowed to use any of the four calculation tiers. Beginning with the 2011 reporting year, all facilities were required to submit full reports.

** Value is between 0 and 0.05%.

Best Available Monitoring Methods (BAMM)

When facilities became subject to the GHGRP, they were allowed to optionally use a best available monitoring method (BAMM) to determine emissions from specific emissions sources for a limited amount of time. The use of BAMM was allowed because it was not always feasible for a newly subjected facility to acquire, install, and operate all of the required monitoring equipment by the date required by the GHGRP. EPA's BAMM provision provided time for these facilities to replace their equipment in a way that could minimize impacts to normal business operations. From January 1, 2010 to March 31, 2010, some Minerals Sector facilities were allowed to use BAMM. Learn more about BAMM.

When the BAMM period expired, Minerals Sector facilities were required to follow applicable monitoring and QA/QC requirements unless an extension was approved by EPA. Minerals sector facilities were eligible to apply to use BAMM through December 31, 2010.

Table 12: BAMM Use as Percent of Facilities

BAMM Use	2010	2011	2012
Cement Production	0%	Not allowed	Not allowed
Glass Production	0%	Not allowed	Not allowed
Lime Manufacturing	15%	Not allowed	Not allowed
Soda Ash Production	0%	Not allowed	Not allowed
Other Minerals	10%	Not allowed	Not allowed

Data Verification and Analysis

As a part of the reporting and verification process, EPA evaluates annual GHG reports with electronic checks. EPA contacts facilities regarding potential reporting issues and facilities resubmit reports as errors are identified. Additional information on EPA's verification process is available here.

GLOSSARY

BAMM means Best Available Monitoring Methods. Facilities approved for BAMM may use best available monitoring methods for any parameter (e.g., fuel use, feedstock rates) that cannot reasonably be measured according to the monitoring and QA/QC requirements of a relevant subpart.

Cement Production comprises kilns at facilities that manufacture Portland cement, which is the basic ingredient of concrete, mortar, stucco, and most non-specialty grout. During the cement production process, calcium carbonate ($CaCO_3$) (usually from limestone and chalk) is combined with silica-containing materials (such as sand and shale) and is heated in a cement kiln at a high temperature. To provide heat, fuel is fired inside the kiln, and both process and combustion emissions exit the same stack. Cement kilns can combust a wide variety of fuels, including fossil fuels and industrial and commercial waste materials. The product of the kiln is clinker, an intermediate product of rock-like nodules that are eventually ground into a powder and mixed with calcium sulfate and other minor constituents to produce the final Portland cement product. This calcination process produces CO_2 as a by-product, and the CO_2 is released to the atmosphere. Small amounts of other carbonates and organic carbon can also be present in the raw materials, both of which generate additional CO_2.

Direct emitters are facilities that combust fuels or otherwise put greenhouse gases into the atmosphere directly from their facility. Alternatively, **Suppliers** are entities that supply certain fossil fuels or fluorinated gases into the economy that – when combusted, released or oxidized – emit greenhouse gases into the atmosphere.

EIA MECS. EIA is the U.S. Energy Information Administration. MECS is the Manufacturing Energy Consumption Survey, which is a national sample survey that collects information on the stock of U.S. manufacturing establishments, their energy-related building characteristics, and their energy consumption and expenditures.

FLIGHT refers to EPA's GHG data publication tool, named Facility Level Information on Greenhouse Gases Tool (http://ghgdata.epa.gov/ghgp).

GHGRP means EPA's Greenhouse Gas Reporting Program (40 CFR part 98).

GHGRP vs. GHG Inventory: EPA's Greenhouse Gas Reporting Program (GHGRP) collects and disseminates annual greenhouse gas data from individual facilities and suppliers across the U.S. economy. EPA also develops the annual Inventory of U.S. Greenhouse Gas Emissions and Sinks (GHG Inventory) to track total national emissions of greenhouse gases to meet U.S. government commitments to the United Nations Framework Convention on Climate Change. The GHGRP and Inventory datasets are complementary and may inform each other over time. However, there are also important differences in the data and approach. For more information, please see https://www.epa.gov/ghgreporting/greenhouse-gas-reporting-program-and-us-inventory-greenhouse-gas-emissions-and-sinks.

Glass Production comprises facilities that manufacture glass (including flat, container, or pressed and blown glass) or wool fiberglass using continuous glass melting furnaces. Experimental furnaces and research and development process units are excluded. Emissions from glass production come from fuel combustion to melt the raw materials used to make glass and from chemical transformation of the raw materials when they are heated in the glass furnace. The raw materials used in glass manufacturing include silica (SiO_2); carbonates, such as limestone ($CaCO_3$), dolomite ($CaMg(CO_3)_2$), and soda ash (Na_2CO_3); and other minor ingredients. When heated in glass melting furnaces, these materials form CO_2, which is subsequently emitted from the furnace.

Lime Manufacturing comprises facilities that manufacture marketed and non-marketed lime products (e.g., calcium oxide, high-calcium quicklime, calcium hydroxide, hydrated lime, dolomitic quicklime, dolomitic hydrate, or other lime products) by calcination of limestone, dolomite, shells or other calcareous substances. The sector excludes lime kilns located at kraft pulp mills, soda pulp mills, sulfite pulp mills; and kilns that process sludge containing only calcium carbonate from water softening processes.

MMT means million metric tons.

NAICS means the North American Industry Classification System, the standard used by federal statistical agencies to classify business establishments into industrial categories for collecting and publishing statistical data related to the U.S. economy.

Other Minerals comprises facilities that reported under subpart C only (general stationary fuel combustion sources) and reported NAICS codes starting with 327 (Nonmetallic Mineral Product Manufacturing).

Soda Ash Manufacturing refers to a manufacturing process that produces soda ash by calcining trona, calcining sodium sesquicarbonate, or using a liquid alkaline feedstock process that directly produces CO_2.

USGS is the U.S. Geological Survey.