

## PULP AND PAPER SECTOR

### Highlights

- Emissions from the 232 facilities in the Pulp and Paper Sector were 42.1 million metric tons CO<sub>2</sub>e in 2012.
- Emissions from this sector decreased by four percent from 2010 to 2011, and decreased by an additional five percent from 2011 to 2012.
- The decrease in emissions is attributed to decreased use of coal, coke, and petroleum products and increased use of natural gas.

All emissions presented here are as of 9/1/2013 and exclude biogenic CO<sub>2</sub>.

### About this Sector

The Pulp and Paper Sector consists of two subsectors:

- (1) Chemical pulp and paper manufacturing, and
- (2) Other paper producers.

The chemical pulp and paper subsector comprises facilities that manufacture pulp using chemical pulping processes, including integrated mills that produce virgin pulp for use in on-site paper making and non-integrated mills that produce only market pulp.

The other paper producers subsector consists of mills that use non-chemical pulping processes (e.g. mechanical or secondary (recycled) fiber pulping) and non-integrated facilities that produce paper products from purchased pulp, produce secondary fiber from recycled paper, convert paper into paperboard products, operate coating and laminating processes, and print products such as newspapers, books, labels, business cards, stationery, and business forms. Emissions from the Other Paper Producers subsector are only from stationary fuel combustion. These facilities reported a primary NAICS code beginning with 322 (paper manufacturing) or 323 (printing and related support activities).

Emissions from industrial landfills and industrial wastewater treatment at these facilities are included in the Waste Sector and are thus excluded from the Pulp and Paper Sector.

### Who Reports?

In 2012, 232 facilities in the Pulp and Paper Sector reported emissions of 42.1 million metric tons of carbon dioxide equivalent (MMT CO<sub>2</sub>e). The Pulp and Paper Sector reflects three percent of the facilities reporting direct emissions to the GHGRP and 0.6% of total U.S. GHG emissions.<sup>a</sup>

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<sup>a</sup> The total U.S. GHG emissions are 6,525.6 MMT CO<sub>2</sub>e 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: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>.

**Table 1: Pulp and Paper Sector – Reporting Schedule by Subpart**

Subpart	Source Category	Applicability	First Reporting Year
AA	Chemical Pulp and Paper Manufacturing	Facilities emitting $\geq 25,000$ metric tons CO <sub>2</sub> e/year	2010
C	Other Paper Producers (non-chemical and/or non-integrated pulp and paper mills)	Facilities that did not report under subpart AA, but that emit $\geq 25,000$ metric tons CO <sub>2</sub> e/year from stationary fuel combustion and reported a primary NAICS code beginning with 322 (paper manufacturing) or 323 (printing and related support activities). <sup>a</sup>	2010

<sup>a</sup> Four facilities in 2010 and seven facilities in 2011 and 2012 that reported under NAICS codes beginning with 322 and 323, are not included in the Pulp and Paper Sector totals. These facilities were assigned to the Power Plant or Waste Sectors based on other reported emissions sources (see <http://www.ccdsupport.com/confluence/display/ghgp/Calculating+GHG+Totals+by+Industry>).

**Table 2: Pulp and Paper Sector – Number of Reporters (2010–2012)**

Pulp and Paper Sector	Number of Reporters		
	2010	2011	2012
<b>Total Pulp and Paper Sector</b>	<b>229</b>	<b>231</b>	<b>232</b>
Chemical Pulp and Paper Manufacturing	110	110	110
Other Paper Producers (Subpart C only)	119	121	122

**Table 3: Pulp and Paper 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
Chemical Pulp and Paper Manufacturing	Facilities emitting $\geq 25,000$ metric tons CO <sub>2</sub> e/year	100% <sup>a</sup>	100%
Other Paper Producers	Facilities emitting $\geq 25,000$ metric tons CO <sub>2</sub> e/year from stationary fuel combustion that reported a primary NAICS code beginning with 322 or 323 and reported under Subpart C but not AA.	51% <sup>b</sup>	84-95% <sup>c</sup>

<sup>a</sup> The GHGRP coverage of the industry and estimated percent of facilities covered by the GHGRP was determined by comparing information on pulp mill processes from the 2011 EPA/OAQPS ICR data base and the mill list from GHGRP year 2012. All facilities that produce chemical pulp and operate subpart AA equipment are covered. A few pulp mills with unique chemical processes that do not involve subpart AA equipment (e.g., calcium-based sulfite mills that do not operate chemical recovery combustion units) report under subpart C but not subpart AA and are counted as other paper producers in the table.

<sup>b</sup> The GHGRP coverage of the industry and percent of facilities covered by the GHGRP was estimated by comparing the number of other paper producers in the 2011 EPA/OAQPS ICR (241) with the number of Other paper producers reporting under the GHGRP in 2012 (122).

<sup>c</sup> To estimate the percentage of total emissions from other paper producers that are reported to the GHGRP, EPA divided the total reported emissions from these sources by two estimates of total industry emissions. The low end estimate was based on the assumption that the 119 other paper producers not reporting to the GHGRP emit an average of 20,000 mt CO<sub>2</sub>e per year. The high end estimate was based on the assumption that these other paper producers emit an average of 5,000 MT CO<sub>2</sub>e per year.

## Reported Emissions

All GHG emissions data, displayed in units of carbon dioxide equivalent (CO<sub>2</sub>e) reflect the global warming potential (GWP) values from the Intergovernmental Panel on Climate Change (IPCC), 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, published in the Federal Register on October 30, 2009 (74 FR 56395).

The pulp and paper sector is unique in that it generates more greenhouse gas emissions from combustion of biomass than fossil fuels (See Table 4 and Table 7). Carbon dioxide emissions from biogenic materials are accounted for separately from those of fossil fuels. Biogenic CO<sub>2</sub> comes from combustion of spent pulping liquors (i.e., biomass) in chemical recovery combustion units (which recover inorganic pulping chemicals for reuse in the pulping process) and from the combustion of wood fuels in other stationary fuel combustion units. Non-biogenic CO<sub>2</sub> comes from fossil fuel combustion in chemical recovery systems, lime kilns, and other fuel combustion sources; and from the addition of carbonaceous makeup chemicals in chemical recovery systems.

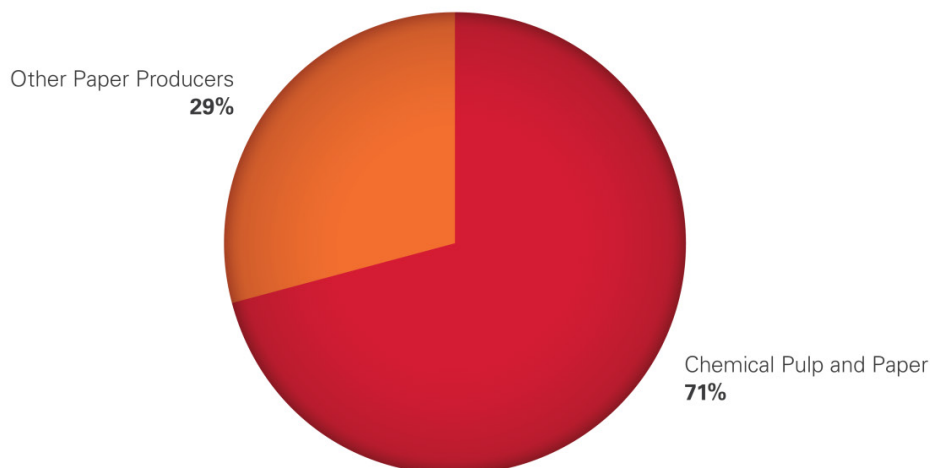
**Table 4: Pulp and Paper Sector – Emissions by Subsector (2010–2012)**

Pulp and Paper Sector	Emissions (MMT CO <sub>2</sub> e) <sup>a,b</sup>		
	2010	2011	2012
<b>Total Pulp and Paper Sector</b>	<b>45.8</b>	<b>43.8</b>	<b>42.1</b>
Pulp and Paper Manufacturing	32.1	30.5	29.8
Other Paper Producers	13.8	13.3	12.3

<sup>a</sup> These values represent total emissions reported to the GHGRP in these industry sectors. Additional emissions may occur at facilities that have not reported, for example those below the 25,000 metric ton CO<sub>2</sub>e reporting threshold.

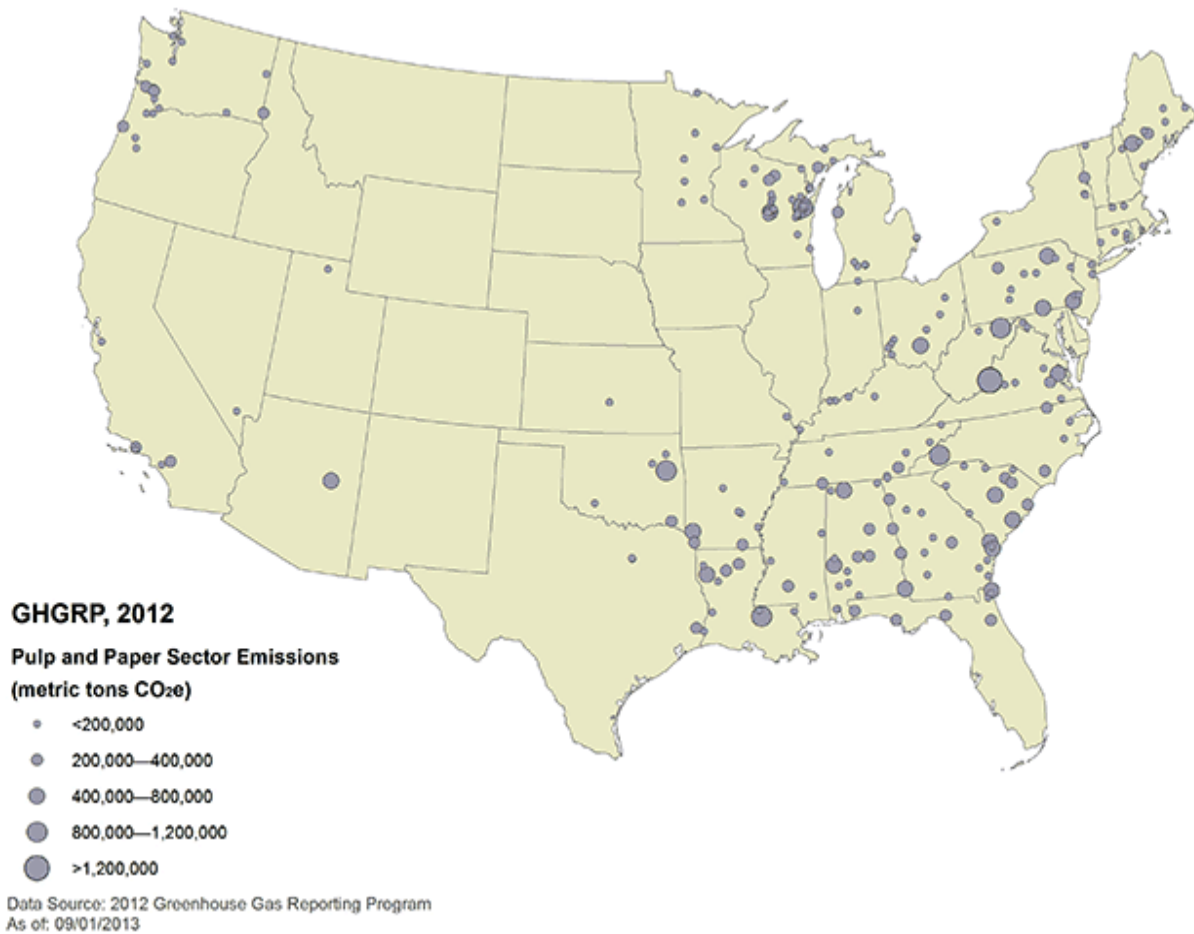
<sup>b</sup> Totals may not sum due to independent rounding.

**Figure 1: Pulp and Paper Sector – Emissions by Subsector (2012)**



[Click here to view the most current data using FLIGHT.](#)

**Figure 2: Location and Emissions Range for Each Reporting Facility in the Pulp and Paper Sector (as of 9/1/2013)**

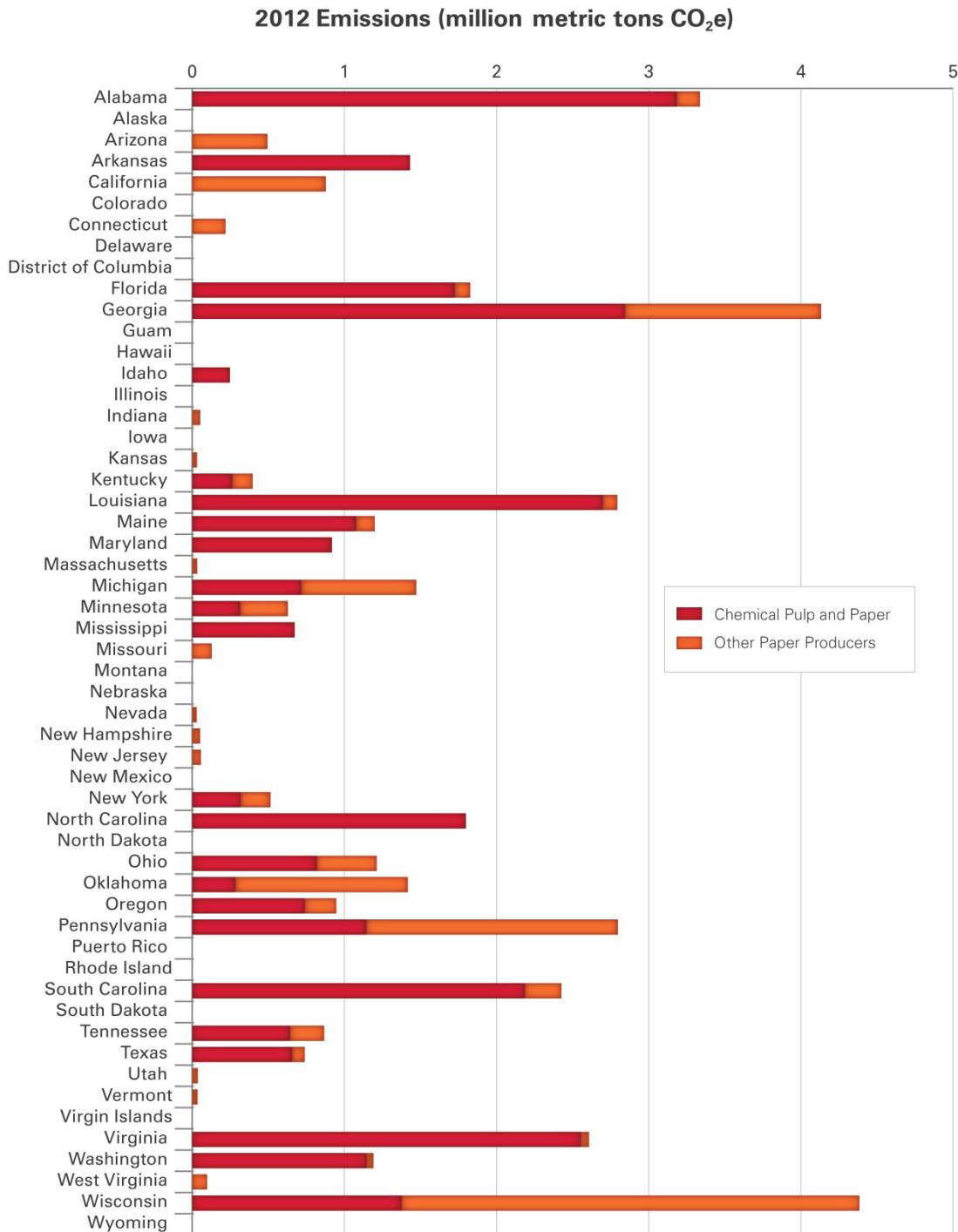


This map shows the locations of direct-emitting facilities. The size of a circle corresponds to the quantity of emissions reported by that facility.

Readers can [identify the largest emitting facilities](http://ghgdata.epa.gov) by visiting the Facility Level Information on Greenhouse Gases (FLIGHT) website (<http://ghgdata.epa.gov>).

Figure 3: Pulp and Paper Sector – Emissions by State (2012)<sup>a</sup>

**DIRECT EMISSIONS BY STATE FROM THE PULP & PAPER SECTOR**



<sup>a</sup> 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.  
[Click here to view the most current data using FLIGHT.](#)

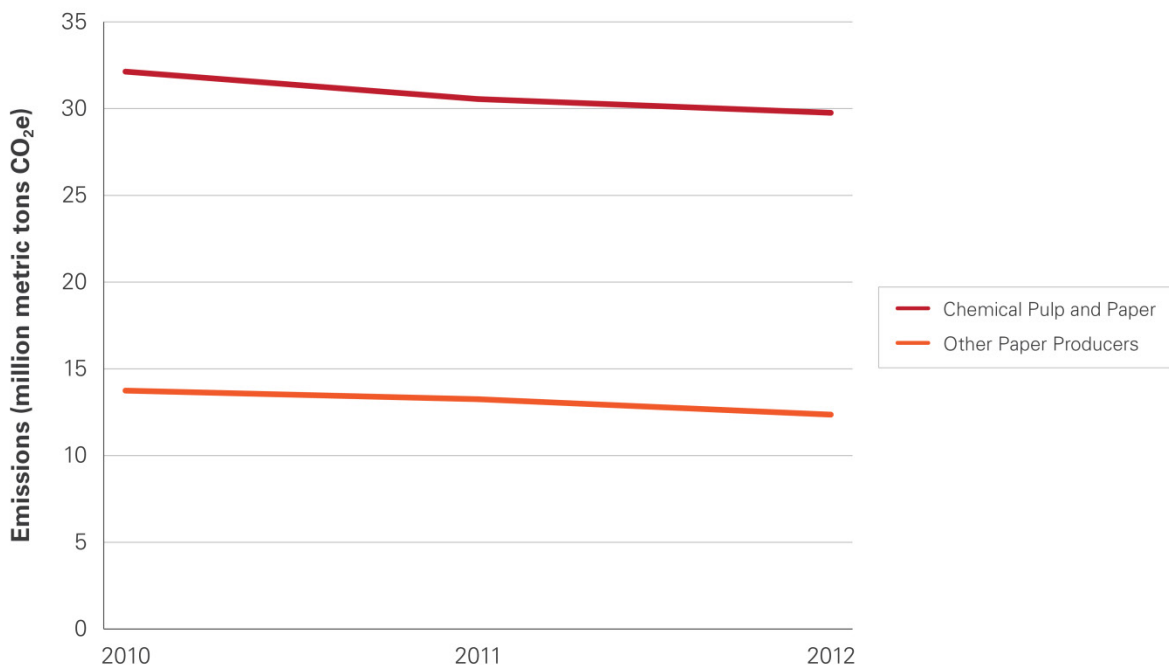
### Pulp and Paper Sector Emissions Trends 2010 to 2011

In 2011, emissions reported for the Pulp and Paper Sector decreased by 2.1 MMT CO<sub>2</sub>e (five percent) from 2010 levels even though two additional reporters in the other paper producers subsector began reporting. Emissions decreased in both the chemical pulp and paper manufacturing and other paper producers subsectors. The decrease in emissions is most likely attributed to changes in the fuel mix, including decreased use of coal, coke, and petroleum products and increased use of natural gas.

### Pulp and Paper Sector Emissions Trends 2011 to 2012

In 2012, emissions reported for the Pulp and Paper Sector decreased by 1.6 MMT CO<sub>2</sub>e (four percent) from 2011 levels even though one additional reporter in the other paper producers subsector began reporting. Emissions decreased in both the chemical pulp and paper manufacturing and other paper producers subsectors. As in the prior reporting year, the continued decrease in overall sector emissions is most likely attributed to changes in the fuel mix, including decreased use of coal, coke, and petroleum products and increased use of natural gas.

**Figure 4: Pulp and Paper Sector – Emissions Trend (2010–2012)**



[Click here to view the most current data using FLIGHT.](#)

**Table 5: Pulp and Paper Sector – Emissions by GHG (MMT CO<sub>2</sub>e)<sup>a</sup>**

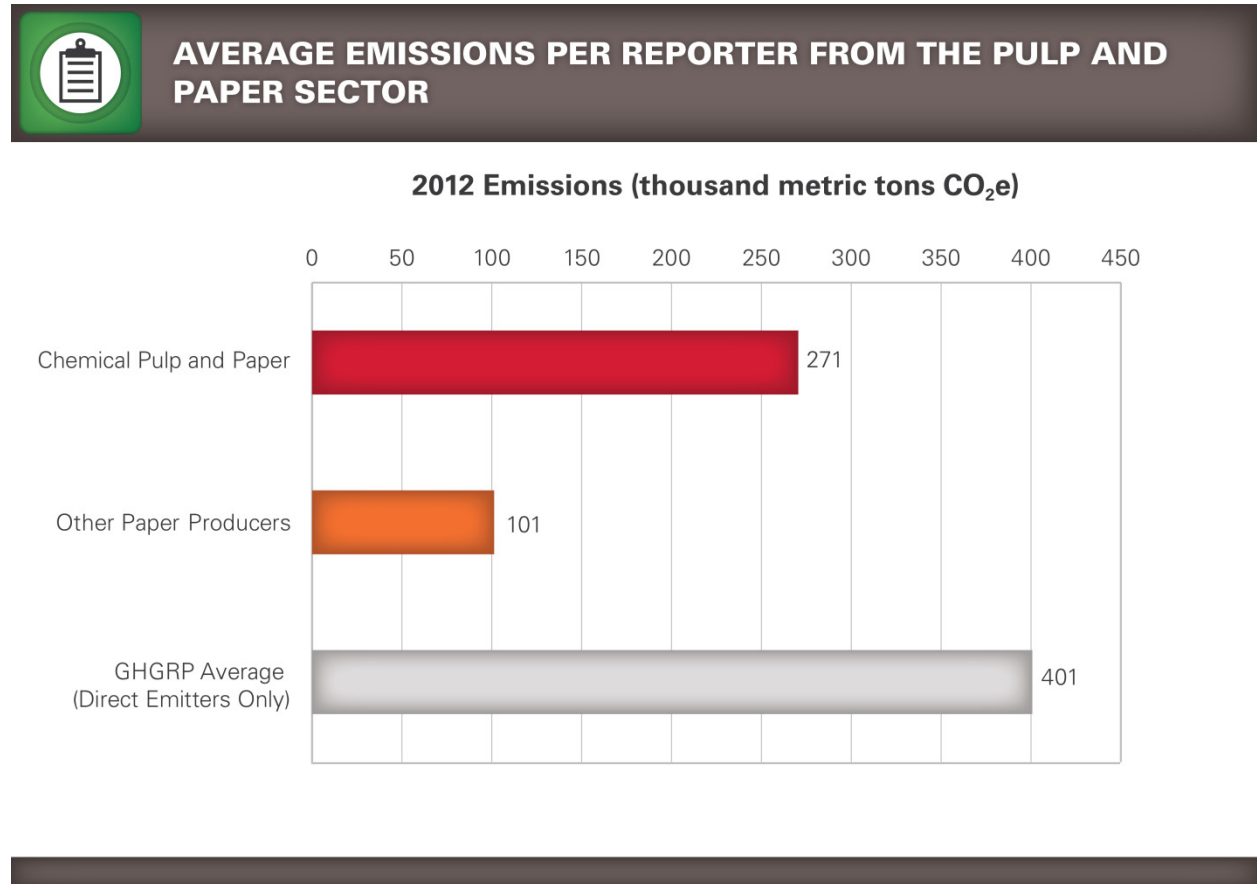
Pulp and Paper Sector	Reporting Year		
	2010	2011	2012
<b>Number of facilities</b>	229	231	232
<b>Total emissions (MMT CO<sub>2</sub>e)<sup>b</sup></b>	45.8	43.8	42.1
<b>Emissions by GHG</b>			
<b>Carbon dioxide (CO<sub>2</sub>)</b>			
• Pulp and Paper Manufacturing	29.3	27.7	27.0
• Other Paper Producers	13.6	13.2	12.3
<b>Methane (CH<sub>4</sub>)</b>			
• Pulp and Paper Manufacturing	0.8	0.9	0.8
• Other Paper Producers	**	**	**
<b>Nitrous oxide (N<sub>2</sub>O)</b>			
• Pulp and Paper Manufacturing	1.9	1.9	1.9
• Other Paper Producers	0.1	0.1	0.1

<sup>a</sup> 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<sub>2</sub>e reporting threshold.

<sup>b</sup> Totals may not sum due to independent rounding.

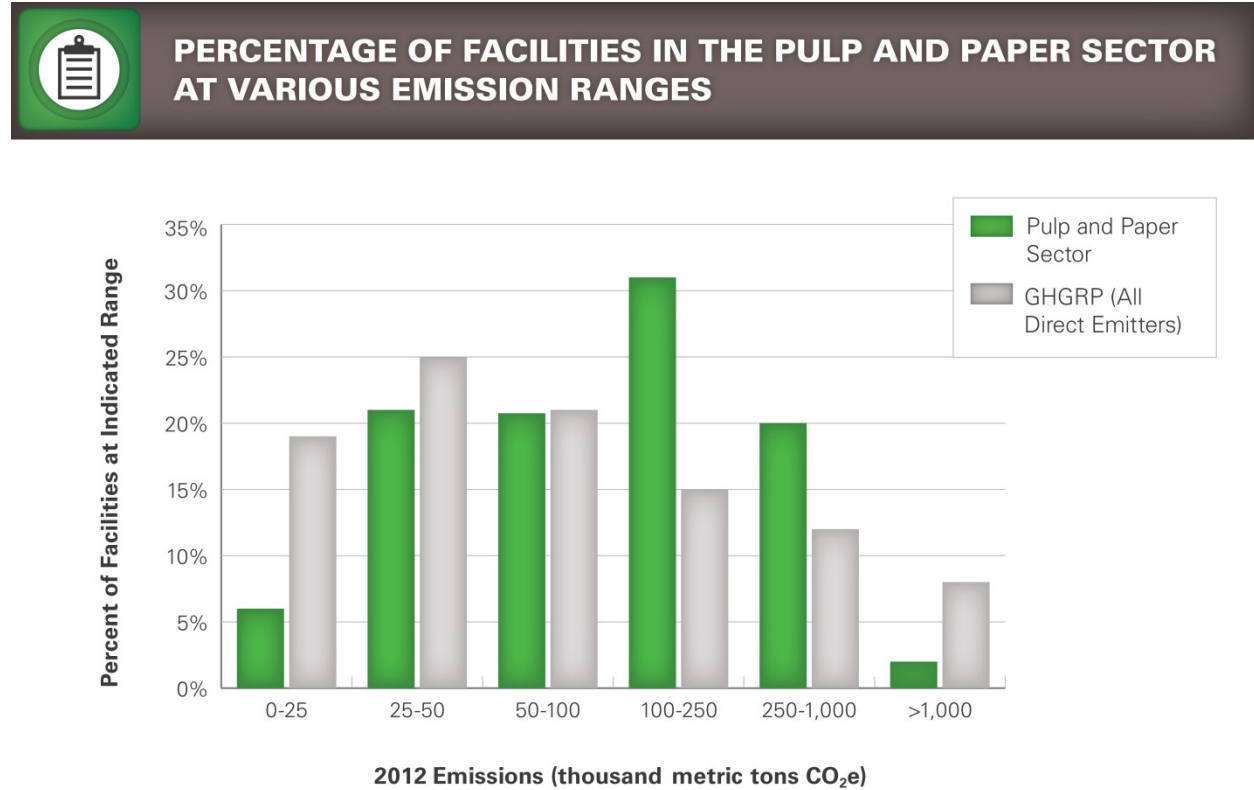
\*\* Total reported emissions are less than 0.05 MMT CO<sub>2</sub>e.

**Figure 5: Pulp and Paper Sector – Average Emissions per Reporter (2012)**



**Table 6: Pulp and Paper Sector – Number of Reporters by Range of Emissions (2012)**

Pulp and Paper Sector	Emissions Range (MMT CO <sub>2</sub> e)					
	0 - 0.025	0.025 - 0.05	0.05 - 0.1	0.1 - 0.25	0.25 - 1	> 1
<b>Total Pulp and Paper Sector</b>	<b>15</b>	<b>48</b>	<b>48</b>	<b>71</b>	<b>46</b>	<b>4</b>
Pulp and Paper Manufacturing		5	12	53	37	3
Other Paper Producers	15	43	36	18	9	1

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

### Emissions from Combustion of Biomass

Biogenic CO<sub>2</sub> emissions result primarily from combustion of the spent pulping liquor in the chemical recovery furnace and from combustion of woody biomass and other biogenic fuels in boilers and other combustion units. As shown in Table 7, emissions of biogenic CO<sub>2</sub> increased by 0.4 MMT (<1%) from 120.2 MMT in 2010 to 120.6 MMT in 2011. Emissions of biogenic CO<sub>2</sub> increased by another 0.4 MMT to a total of 121.0 from 2011 to 2012.



**Table 7: Pulp and Paper Sector – Biogenic CO<sub>2</sub> Emissions (2010–2012)**

Pulp and Paper Sector	Biogenic CO <sub>2</sub> Emissions (million metric tons CO <sub>2</sub> ) <sup>a</sup>		
	2010	2011	2012
<b>Total biogenic CO<sub>2</sub> emissions</b>	<b>120.2</b>	<b>120.6</b>	<b>121.0</b>
Pulp and Paper Manufacturers			
• Spent liquor combustion (Subpart AA)	81.8	82.6	84.2
• Wood and other biomass combustion (Subpart C )	36.2	35.3	35.3
Other Paper Producers			
• Wood and other biomass combustion (Subpart C only)	2.1	2.8	2.7

<sup>a</sup> Totals may not sum due to independent rounding.

### Calculation Methods Used

At pulp and paper facilities, GHGs are emitted from (1) combustion of fossil fuel and spent pulping liquor in chemical recovery units, (2) makeup chemicals added into the chemical recovery system, (3) fuel combustion in lime kilns and other stationary combustion units, and (4) sorbent use in acid gas control systems on stationary fuel combustion sources. Tables 8 through 11 summarize the types of emissions that are included for calculating both non-biogenic emissions and biogenic CO<sub>2</sub> and the calculation methods used.

- **Chemical recovery units.** Chemical pulping facilities measure spent liquor combusted and either HHV or carbon content, depending on the type of chemical recovery unit (chemical recovery furnace at kraft or soda pulp mills or chemical recovery combustion unit at sulfite or stand-alone semi-chemical pulp mills).
- **Stationary fuel combustion.** Combustion emissions are calculated using the tier calculation methods of subpart C with some modifications.
- **Makeup chemical use:** All facilities using carbonaceous makeup chemicals must measure the amount of makeup chemical used either directly or indirectly, and use the ratio of the molecular weight of the makeup chemical (i.e., CaCO<sub>3</sub> or Na<sub>2</sub>CO<sub>3</sub>) to CO<sub>2</sub> to determine CO<sub>2</sub> emissions. Makeup chemical emissions of CO<sub>2</sub> were reported by 42 facilities in 2012.
- **Sorbent use:** For boilers with acid gas control systems, facilities must estimate CO<sub>2</sub> emissions from sorbent use by following subpart C, which specifies using company records and reaction stoichiometry to estimate emissions (if these emissions are measured with a CEMS). Emissions from use of sorbent in acid gas control systems were reported by five pulp and paper facilities in 2012.

**Table 8: Chemical Pulp and Paper Production – Methodologies for Emissions Other than Biogenic CO<sub>2</sub>**

Type of Emissions	Methodology	Portion of Emissions Monitored by Method (by Type)		
		2010	2011	2012
Makeup chemicals	Mass balance	100%	100%	100%
CH <sub>4</sub> and N <sub>2</sub> O from combustion of spent liquor solids in chemical recovery units	Measurements of spent liquor combusted and either high heating value (HHV) or carbon content <sup>a</sup>	100%	100%	100%
CO <sub>2</sub> from combustion of fossil fuels in lime kilns, chemical recovery units, and other fuel combustion units	CEMS (Tier 4)	27.4%	44.4%	41.6%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	24.6%	12.3%	9.5%
	Measured HHVs and default emissions factors (Tier 2)	32.5%	27.9%	34.0%
	Default HHVs and emission factors (Tier 1)	15.5%	15.4%	14.9%
CH <sub>4</sub> and N <sub>2</sub> O from combustion of fossil fuels in lime kilns, chemical recovery systems, and other fuel combustion units	Follow Subpart C method <sup>b</sup>	100%	100%	100%
Sorbent use	Follow Subpart C method	100%	100%	100%

<sup>a</sup> The methodology for kraft and soda mills uses HHV and emission factors. The methodology for sulfite and stand-alone semi-chemical mills uses carbon content.

<sup>b</sup> For lime kilns, the subpart C equations are used with CH<sub>4</sub> and N<sub>2</sub>O emission factors in subpart AA.

**Table 9: Chemical Pulp and Paper Production – Methodologies for Biogenic CO<sub>2</sub>**

Type of Emissions	Methodology	Portion of Emissions Monitored by Method (by Type)		
		2010	2011	2012
CO <sub>2</sub> from combustion of spent liquor solids in chemical recovery units	Measurements of spent liquor combusted either high heating value (HHV) or carbon content <sup>a</sup>	100%	100%	100%
CO <sub>2</sub> from combustion of biomass fuels in other fuel combustion units	CEMS (Tier 4)	7.8%	25.3%	26.5%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	1.6%	1.1%	1.3%
	Measured HHVs and default emissions factors (Tier 2)	7.9%	7.2%	5.7%
	Default HHVs and emission factors (Tier 1)	82.6%	66.4%	66.5%

<sup>a</sup> The methodology for kraft and soda mills uses HHV and emission factors. The methodology for sulfite and stand-alone semi-chemical mills uses carbon content.

**Table 10: Other Paper Producers – Methodologies for Emissions Other than Biogenic CO<sub>2</sub>**

Type of Emissions	Methodology	Portion of Emissions Monitored by Method (by Type)		
		2010	2011	2012
CO <sub>2</sub> from combustion of fossil fuels	CEMS (Tier 4)	9.4%	23.0%	24.0%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	27.1%	18.0%	12.3%
	Measured high heating values (HHVs) and default emissions factors (Tier 2)	37.9%	34.7%	33.8%
	Default HHVs and emission factors (Tier 1)	25.7%	24.3%	30.3%
CH <sub>4</sub> and N <sub>2</sub> O from combustion of fossil fuels	Follow subpart C method	100%	100%	100%

**Table 11: Other Paper Producers – Methodologies for Biogenic CO<sub>2</sub>**

Type of Emissions	Methodology	Percentage of Emissions Monitored by Method (by Type)		
		2010	2011	2012
CO <sub>2</sub> from combustion of biomass in fuel combustion units	CEMS (Tier 4)	7.7%	29.3%	25.0%
	Measured carbon content, and, if applicable, molecular weight (Tier 3)	0.0%	1.2%	1.5%
	Measured high heating values (HHVs) and default emissions factors (Tier 2)	23.3%	20.0%	24.0%
	Default HHVs and emission factors (Tier 1)	68.9%	49.5%	49.5%

### 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](#).

The OAQPS 2011 Information Collection Request (ICR) was an outside data source used to aid in GHG data verification. The 2011 ICR data were consulted to check for missing facilities, confirm the presence or absence of a particular emission unit, or check on the type(s) of fuel combusted in an emission unit.

## GLOSSARY

**CO<sub>2</sub>e** means carbon dioxide equivalent.

**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 into the economy certain fossil fuels or fluorinated gases that—when combusted, released or oxidized—emit greenhouse gases into the atmosphere.

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

**GHGRP** means EPA's Greenhouse Gas Reporting Program.

**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 <http://www.epa.gov/ghgreporting/ghgdata/reported/inventory.html>.

**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.

**OAQPS** means the EPA Office of Air Quality Planning and Standards.