

## 10. Recalculations and Improvements

Each year, emission and sink estimates are recalculated and revised for all years in the Inventory of U.S. Greenhouse Gas Emissions and Sinks, as attempts are made to improve both the analyses themselves, through the use of better methods or data, and the overall usefulness of the report. In this effort, the United States follows the 2006 IPCC Guidelines (IPCC 2006), which states, “Both methodological changes and refinements over time are an essential part of improving inventory quality. It is *good practice* to change or refine methods” when: available data have changed; the previously used method is not consistent with the IPCC guidelines for that category; a category has become key; the previously used method is insufficient to reflect mitigation activities in a transparent manner; the capacity for inventory preparation has increased; new inventory methods become available; and for correction of errors.”

The results of all methodological changes and historical data updates are presented in this section; detailed descriptions of each recalculation are contained within each source’s description found in this report, if applicable. Table 10-1 summarizes the quantitative effect of these changes on U.S. greenhouse gas emissions and Table 10-2 summarizes the quantitative effect on net CO<sub>2</sub> flux to the atmosphere, both relative to the previously published U.S. Inventory (i.e., the 1990 through 2008 report). These tables present the magnitude of these changes in units of teragrams of carbon dioxide equivalent (Tg CO<sub>2</sub> Eq.).

The Recalculations Discussion section of each source presents the details of each recalculation. In general, when methodological changes have been implemented, the entire time series (i.e., 1990 through 2008) has been recalculated to reflect the change, per IPCC (2006). Changes in historical data are generally the result of changes in statistical data supplied by other agencies.

The following emission sources, which are listed in descending order of absolute average annual change in emissions between 1990 and 2008, underwent some of the most important methodological and historical data changes. A brief summary of the recalculations and/or improvements undertaken is provided for each emission source.

- *Natural Gas Systems (CH<sub>4</sub>)*. For the current Inventory, methodologies for gas well cleanups and condensate storage tanks were revised, and new data sources for centrifugal compressors with wet seals, unconventional gas well completions, and unconventional gas well workovers were used, relative to the previous Inventory. The net effect of these changes was an increase in total CH<sub>4</sub> emissions from natural gas systems of between 46.5 and 119.7 percent each year between 1990 and 2008, resulting in an overall annual average increase of 79.3 Tg CO<sub>2</sub> Eq. (66.4 percent). The natural gas production segment accounted for the largest increases, largely due to the methodological changes to gas well cleanups and the addition of unconventional gas well completions and workovers.
- *Landfills (CH<sub>4</sub>)*. Changes in CH<sub>4</sub> emissions from Landfills relative to the previous Inventory resulted from improvements made to better associate flares with the correct landfills or Landfill Gas to Energy projects across the nation. In addition, steps were also taken to further characterize the food waste decay rate. A weighted component-specific decay rate for food waste of 0.156 yr<sup>-1</sup> was used in the current Inventory, replacing the previous Inventory’s default food waste decay rate of 0.185 yr<sup>-1</sup>. These revisions impacted emission estimates for the entire time series and resulted in an average annual decrease of 8.3 Tg CO<sub>2</sub> Eq. (6.5 percent) in CH<sub>4</sub> emissions from Landfills for the period 1990 through 2008.
- *Manure Management (CH<sub>4</sub>)*. Changes in CH<sub>4</sub> emissions from Manure Management relative to the previous Inventory resulted from several updates. Volatile solid production rates for all animal types were updated based on data from the USDA and EPA’s Cattle Enteric Fermentation Model. In addition, USDA data on swine were re-categorized, which changed the typical animal mass for two categories. These changes impacted emission estimates for the entire time series and resulted in an average annual increase of 3.5 Tg CO<sub>2</sub> Eq. (9.4 percent) in CH<sub>4</sub> emissions from Manure Management across the entire time series relative to the previous Inventory.
- *Agricultural Soil Management (N<sub>2</sub>O)*. Changes in N<sub>2</sub>O emissions from Agricultural Soil Management relative to the previous Inventory resulted from methodological changes for estimating grassland areas and livestock manure nitrogen. These recalculations have opposing effects on emissions; grassland area was reduced, resulting in lower emissions, and livestock manure nitrogen increased, resulting in higher emissions. These changes affected the entire time series, resulting in an average annual reduction in N<sub>2</sub>O emissions of 3.2 Tg CO<sub>2</sub> Eq. (1.5 percent) for the period 1990 through 2008 relative to the previous Inventory.

- *Iron and Steel Production & Metallurgical Coke Production (CO<sub>2</sub>)*. A calculation error in the previous Inventory regarding coal tar production and coke breeze production estimates was corrected for the current Inventory, resulting in an average annual decrease in CO<sub>2</sub> emissions from Iron and Steel Production & Metallurgical Coke Production of 2.2 Tg CO<sub>2</sub> Eq. (2.7 percent) for the period 1990 through 2008.
- *Non-Energy Uses of Fossil Fuels (CO<sub>2</sub>)*. Updates to the EIA Manufacturer's Energy Consumption Survey (MECS) for 2006 resulted in changes to CO<sub>2</sub> emissions from Non-Energy Uses of Fossil Fuels for 2003 through 2008 relative to the previous Inventory. Adjustments were made to the entire MECS time series to remove scrap tire consumption for use as a fuel, which is associated with the Waste Incineration chapter. In addition, emissions from synthetic rubber were revised across the entire time series. These changes impacted emission estimates from 1990 through 2008 resulting in an average annual decrease in CO<sub>2</sub> emissions of 1.4 Tg CO<sub>2</sub> Eq. (1.0 percent) across the entire time series.
- *Petroleum Systems (CH<sub>4</sub>)*. Well completion venting, well drilling, and offshore platform activity factors were updated relative to the previous Inventory from existing data sources from 1990 onward, and the emission factor for venting from fixed roof storage tanks in the crude oil production segment was increased to reflect the occurrence of gas venting through storage tanks. These changes affected the entire time series from Petroleum Systems, resulting in an average annual increase in CH<sub>4</sub> emissions of 1.3 Tg CO<sub>2</sub> Eq. (4.3 percent) for the period 1990 through 2008 relative to the previous report.
- *Nitric Acid Production (N<sub>2</sub>O)*. Changes in N<sub>2</sub>O emission from Nitric Acid Production relative to the previous Inventory resulted from updated information on abatement technologies in use at production facilities and revised production data from the U.S. Census Bureau. These changes resulted in an average annual decrease in N<sub>2</sub>O emissions of 1.3 Tg CO<sub>2</sub> Eq. (6.7 percent) across the entire time series relative to the previous report.
- *Electrical Transmission and Distribution (SF<sub>6</sub>)*. SF<sub>6</sub> emission estimates for the period 1990 through 2008 were updated relative to the previous Inventory based on (1) new data from EPA's SF<sub>6</sub> Emission Reduction Partnership; (2) revisions to interpolated and extrapolated non-reported Partner data; and (3) a correction made to 2004 transmission mile data for a large Partnership utility that had been interpreted incorrectly from the UDI database in previous years. In addition, the method for estimating potential emissions from the sector was updated for the current Inventory to assume that all SF<sub>6</sub> purchased by equipment manufacturers is either emitted or sent to utilities. These changes affected the entire time series, resulting in an average annual increase of 1.2 Tg CO<sub>2</sub> Eq. (6.6 percent) for the period 1990 through 2008 relative to the previous report.
- *Forestland Remaining Forestland (C Sink)*. Changes to the estimated carbon stored in Forestland Remaining Forestland stemmed from recent additions to the Forest Inventory and Analysis Database (FIADB). Newer annual inventory data for most states including Oklahoma, California, Oregon, and Washington were added. Some older periodic inventories for some southern states were also updated. These changes resulted in an average annual increase in carbon stored in forestland of 6.8 Tg CO<sub>2</sub> Eq. (2.4 percent) for the period 1990 through 2008 relative to the previous inventory report.

Table 10-1: Revisions to U.S. Greenhouse Gas Emissions (Tg CO<sub>2</sub> Eq.)

<b>Gas/Source</b>	<b>1990</b>	<b>2000</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
<b>CO<sub>2</sub></b>	<b>(1.1)</b>	<b>(2.2)</b>	<b>5.3</b>	<b>3.9</b>	<b>(0.2)</b>	<b>0.2</b>
Fossil Fuel Combustion	2.7	1.5	(0.1)	0.3	(0.3)	(6.8)
Electricity Generation	+	+	+	NC	+	(2.6)
Transportation	0.2	+	1.3	1.4	0.2	4.7
Industrial	1.0	(1.1)	(2.5)	(2.5)	(0.2)	(16.4)
Residential	(0.8)	(0.5)	(0.5)	(0.5)	0.7	5.5
Commercial	2.3	3.2	2.3	2.6	2.0	4.7
U.S. Territories	NC	NC	(0.7)	(0.7)	(3.0)	(2.7)
Non-Energy Use of Fuels	(1.0)	(1.2)	6.9	4.2	1.9	6.8
Iron and Steel Production & Metallurgical						
Coke Production	(3.0)	(2.2)	(1.8)	(1.8)	(1.8)	(3.0)
Natural Gas Systems	0.3	0.5	0.4	1.2	0.2	2.9
Cement Production	NC	(0.8)	(0.7)	(0.8)	(0.7)	(0.6)
Incineration of Waste	(0.1)	(0.2)	(0.2)	(0.2)	(0.6)	(1.0)

Ammonia Production and Urea Consumption	NC	NC	NC	NC	0.1	0.2
Lime Production	NC	NC	NC	NC	NC	NC
Cropland Remaining Cropland	NC	NC	NC	NC	(0.1)	1.0
Limestone and Dolomite Use	NC	NC	NC	NC	NC	(0.3)
Soda Ash Production and Consumption	NC	NC	NC	NC	NC	NC
Aluminum Production	NC	NC	NC	NC	NC	NC
Petrochemical Production	NC	NC	NC	NC	NC	NC
Carbon Dioxide Consumption	NC	NC	NC	+	NC	NC
Titanium Dioxide Production	NC	NC	NC	NC	NC	NC
Ferroalloy Production	NC	NC	NC	NC	NC	NC
Wetlands Remaining Wetlands	NC	NC	NC	NC	NC	0.1
Phosphoric Acid Production	NC	NC	NC	NC	NC	+
Zinc Production	(0.3)	(0.1)	0.6	0.6	0.7	0.8
Lead Production	0.2	0.3	0.3	0.3	0.3	0.3
Petroleum Systems	+	+	+	+	+	+
Silicon Carbide Production and Consumption	NC	NC	NC	NC	NC	NC
<i>Land Use, Land-Use Change, and Forestry</i>						
( <i>Sink</i> ) <sup>a</sup>	47.9	87.7	(106.1)	(105.2)	(105.5)	(100.1)
<i>Biomass - Wood</i> <sup>a</sup>	NC	NC	NC	(4.0)	(4.1)	(0.1)
<i>International Bunker Fuels</i> <sup>a</sup>	+	+	(0.8)	(0.7)	0.6	(1.5)
<i>Biomass - Ethanol</i> <sup>a</sup>	0.1	0.2	0.4	0.5	0.7	1.4
<b>CH<sub>4</sub></b>	<b>61.5</b>	<b>73.9</b>	<b>78.3</b>	<b>103.9</b>	<b>95.4</b>	<b>109.1</b>
Natural Gas Systems	60.3	78.6	86.8	114.6	105.7	115.4
Enteric Fermentation	(0.3)	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)
Landfills	(1.9)	(9.0)	(13.1)	(15.3)	(15.2)	(10.4)
Coal Mining	NC	NC	NC	+	(0.2)	(0.5)
Manure Management	2.4	3.8	4.3	4.4	4.9	4.4
Petroleum Systems	1.5	1.3	1.1	1.1	1.2	1.1
Wastewater Treatment	+	+	+	+	+	0.2
Forest Land Remaining Forest Land	+	+	+	+	+	+
Rice Cultivation	NC	NC	NC	NC	NC	NC
Stationary Combustion	+	+	+	+	+	(0.2)
Abandoned Underground Coal Mines	NC	NC	+	(0.1)	(0.1)	+
Mobile Combustion	+	+	+	+	+	+
Composting	NC	NC	NC	NC	NC	+
Petrochemical Production	NC	NC	NC	NC	NC	NC
Iron and Steel Production & Metallurgical						
Coke Production	NC	NC	NC	NC	NC	NC
Field Burning of Agricultural Residues	(0.5)	(0.6)	(0.7)	(0.7)	(0.7)	(0.7)
Ferroalloy Production	NC	NC	NC	NC	NC	NC
Silicon Carbide Production and Consumption	NC	NC	NC	NC	NC	NC
Incineration of Waste	NC	NC	NC	NC	+	+
<i>International Bunker Fuels</i> <sup>a</sup>	+	+	+	+	+	+
<b>N<sub>2</sub>O</b>	<b>(7.1)</b>	<b>(4.5)</b>	<b>(5.4)</b>	<b>(3.1)</b>	<b>(2.6)</b>	<b>(7.4)</b>
Agricultural Soil Management	(5.7)	(3.3)	(4.5)	(2.3)	(1.6)	(5.1)
Mobile Combustion	+	+	+	+	+	+
Manure Management	0.1	0.4	0.6	0.7	0.8	0.8
Nitric Acid Production	(1.2)	(1.3)	(1.1)	(1.1)	(1.3)	(2.6)
Stationary Combustion	+	+	+	(0.1)	(0.1)	+
Forest Land Remaining Forest Land	+	+	+	+	+	+
Wastewater Treatment	+	+	+	+	+	+
N <sub>2</sub> O from Product Uses	NC	NC	NC	NC	NC	NC
Adipic Acid Production	+	+	NC	NC	NC	NC
Composting	NC	NC	NC	NC	NC	+
Settlements Remaining Settlements	NC	NC	NC	NC	+	(0.1)
Incineration of Waste	NC	NC	NC	NC	+	+

Field Burning of Agricultural Residues	(0.3)	(0.4)	(0.4)	(0.4)	(0.4)	(0.4)
Wetlands Remaining Wetlands	NC	NC	NC	NC	NC	+
<i>International Bunker Fuels<sup>a</sup></i>	+	+	+	+	+	+
<b>HFCs</b>	<b>NC</b>	<b>+</b>	<b>1.0</b>	<b>1.6</b>	<b>2.1</b>	<b>2.5</b>
Substitution of Ozone Depleting Substances	NC	+	1.0	1.6	2.1	2.5
HCFC-22 Production	NC	NC	NC	NC	NC	NC
Semiconductor Manufacture	NC	NC	NC	NC	+	+
<b>PFCs</b>	<b>NC</b>	<b>NC</b>	<b>NC</b>	<b>NC</b>	<b>+</b>	<b>+</b>
Semiconductor Manufacture	NC	NC	NC	NC	+	+
Aluminum Production	NC	NC	NC	NC	NC	NC
<b>SF<sub>6</sub></b>	<b>1.8</b>	<b>1.0</b>	<b>1.2</b>	<b>0.9</b>	<b>0.5</b>	<b>+</b>
Electrical Transmission and Distribution	1.8	1.0	1.2	0.9	0.5	0.3
Magnesium Production and Processing	NC	NC	+	+	+	(0.1)
Semiconductor Manufacture	NC	NC	NC	NC	+	(0.2)
<b>Net Change in Total Emissions<sup>b</sup></b>	<b>55.0</b>	<b>68.2</b>	<b>80.3</b>	<b>107.1</b>	<b>95.3</b>	<b>104.4</b>
<b>Percent Change</b>	<b>0.9%</b>	<b>1.0%</b>	<b>1.1%</b>	<b>1.5%</b>	<b>1.3%</b>	<b>1.5%</b>

+ Absolute value does not exceed 0.05 Tg CO<sub>2</sub> Eq. or 0.05 percent.

Parentheses indicate negative values

NC (No Change)

<sup>a</sup> Not included in emissions total.

<sup>b</sup> Excludes net CO<sub>2</sub> flux from Land Use, Land-Use Change, and Forestry, and emissions from International Bunker Fuels.

Note: Totals may not sum due to independent rounding.

Table 10-2: Revisions to Net Flux of CO<sub>2</sub> to the Atmosphere from Land Use, Land-Use Change, and Forestry (Tg CO<sub>2</sub> Eq.)

<b>Component: Net CO<sub>2</sub> Flux From Land Use, Land-Use Change, and Forestry</b>	<b>1990</b>	<b>2000</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>
Forest Land Remaining Forest Land	48.8	89.4	(105.0)	(105.0)	(105.0)	(99.1)
Cropland Remaining Cropland	NC	NC	NC	NC	NC	NC
Land Converted to Cropland	NC	NC	NC	NC	NC	NC
Grassland Remaining Grassland	(0.1)	+	0.1	0.1	0.2	0.2
Land Converted to Grassland	+	+	0.2	0.3	0.3	0.4
Settlements Remaining Settlements	NC	NC	NC	NC	NC	NC
Other	(0.7)	(1.9)	(1.4)	(0.6)	(1.1)	(1.7)
<b>Net Change in Total Flux</b>	<b>47.9</b>	<b>87.7</b>	<b>(106.1)</b>	<b>(105.2)</b>	<b>(105.5)</b>	<b>(100.1)</b>
<b>Percent Change</b>	<b>5.3%</b>	<b>13.2%</b>	<b>(11.2%)</b>	<b>(11.0%)</b>	<b>(11.0%)</b>	<b>(10.6%)</b>

NC (No Change)

Note: Numbers in parentheses indicate a decrease in estimated net flux of CO<sub>2</sub> to the atmosphere, or an increase in net sequestration.

Note: Totals may not sum due to independent rounding.

+ Absolute value does not exceed 0.05 Tg CO<sub>2</sub> Eq. or 0.05 percent.