9. Recalculations and Improvements

Each year, many emission and sink estimates in the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* are recalculated and revised, as efforts are made to improve the estimates through the use of better methods and/or data with the goal of improving inventory quality and reducing uncertainties, including the transparency, completeness, consistency, and 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; improved inventory methods become available; and/or for correction of errors."

In general, when methodological changes have been implemented, the previous Inventory's time series (i.e., 1990 to 2018) will be recalculated to reflect the change, per guidance in IPCC (2006). Changes in historical data are generally the result of changes in statistical data supplied by other agencies, and do not necessarily impact the entire time series.

The results of all methodological changes and historical data updates made in the current Inventory are presented in Figure 9-1, Table 9-1, and Table 9-2. Figure 9-1 presents the impact of recalculations by sector and on net total emissions across the timeseries. Table 9-1 summarizes the quantitative effect of all changes on U.S. greenhouse gas emissions by gas across the Energy, Industrial Processes and Product Use (IPPU), Agriculture, and Waste sectors, while Table 9-2 summarizes the quantitative effect of changes on annual net fluxes from Land Use, Land-Use Change, and Forestry (LULUCF). Both the figure and tables present results relative to the previously published Inventory (i.e., the 1990 to 2018 report) in units of million metric tons of carbon dioxide equivalent (MMT CO_2 Eq.). To understand the details of any specific recalculation or methodological improvement, see the *Recalculations* within each source/sink categories' section found in Chapters 3 through 7 of this report. A discussion of Inventory improvements in response to review processes is described in Annex 8.

The following source and sink categories underwent the most significant methodological and historical data changes. A brief summary of the recalculations and/or improvements undertaken are provided for these categories.

- *Forest Land Remaining Forest Land: Changes in Forest Carbon Stocks (CO_2).* The methods used in the current Inventory to compile estimates for forest ecosystem carbon stocks and stock changes and harvested wood products (HWPs) from 1990 through 2019 are consistent with those used in the 1990 through 2018 Inventory. However, population estimates of carbon stocks and stock changes were compiled using NFI data from each U.S. state and national estimates were compiled by summing over all states. In past Inventories population estimates were compiled by 4 geographic regions and summed over all regions to compile national estimates. Also, the state-level disaggregation contributed to identifying an error in the compilation of the Alaska time series data resulting in a 1-year misalignment in carbon stock changes for this state in comparison to the 1990 through 2018 Inventory. This error has been corrected resulting in differences in each year of the time series (i.e., 1990-2018), given the 1-yr misalignment, with substantial differences in major fire years in Alaska. Soil carbon stocks decreased in the latest Inventory

relative to the previous Inventory and this change can be attributed to refinements in the Digital General Soil Map of the United States (STATSGO2) dataset where soil orders may have changed in the updated data product. These changes resulted in an average annual increase in C stock change losses of 42.7 MMT CO_2 Eq. (6.5 percent), across the 1990 through 2018 time series, relative to the previous Inventory.

- *Wastewater Treatment (N_2O).* EPA revised the domestic wastewater N_2O methodology based on the *2019 Refinement* (IPCC 2019): added emission estimates from septic systems; added a correction factor to account for nitrogen from household products to POTWs and septic systems (1.17); revised the methodology for treatment plants to account for aerobic and anaerobic treatment systems; updated the emission factor for centralized aerobic systems (from 0 to 0.016 kg N_2O-N/kg N); and revised emission estimates from discharge of domestic wastewater to aquatic environments to account for the condition of the receiving waterbody (i.e., nutrient-impacted/eutrophic conditions, or not impacted) (ERG 2020). All of these changes affected the time series from 1990 through 2018. Domestic wastewater treatment and discharge N_2O emissions increased an average of 435 percent (18.5 MMT CO_2 Eq.) over the time series, with the smallest increase of 421 percent (19.2 MMT CO_2 Eq.) in 2010 and largest increase of 453 percent (15.3 MMT CO_2 Eq.) in 1990. EPA added industrial wastewater N_2O emissions for the first time based on the *2019 Refinement* (IPCC 2019) methodology. These additions are on average 2 percent of wastewater N_2O emissions across the entire time series.

- *Non-Energy Use of Fuels (CO_2).* Adjustments were made to activity data, carbon content coefficients, and heat contents for hydrocarbon gas liquids (HGL) for 1990 to 2018. In previous Inventory reports, HGL activity data from 1990 to 2007 were extracted from the American Petroleum Institute's Sales of Natural Gas Liquids and Liquefied Refinery Gases. Historical HGL activity data from 1990 to 2007 were adjusted to use EIA's Petroleum Supply Annual tables for consistency with the rest of the entire time series (i.e., 2008 to 2019). In addition, the HGL carbon content coefficient for NEU was updated by separating each fuel out by its natural gas liquid (NGL) and associated olefin to calculate a more accurate and annually variable factor, and the heat contents for HGL and pentanes plus were updated using updated data from EIA's Monthly Energy Review (EIA 2020a). Non-energy use of petroleum coke consumption was adjusted to account for leap years when converting from barrels per day to barrels per year. The "miscellaneous products" category reported by EIA includes miscellaneous products that are not reported elsewhere in the EIA data set. The miscellaneous products category reported by EIA was assumed to be mostly petroleum refinery sulfur compounds that do not contain carbon (EIA 2019). Therefore, the carbon content for miscellaneous products was updated to be zero across the time series. Overall, these changes resulted in an average annual decrease of 11.8 MMT CO_2 Eq. (9.5 percent) in carbon emissions from non-energy uses of fossil fuels for the period 1990 through 2018, relative to the previous Inventory. This decrease is primarily due to the removal of miscellaneous products, which previously constituted an average of 8.2 percent of total emissions from 1990 to 2018.

- *Land Converted to Forest Land: Changes in Carbon Stocks (CO_2).* The Land Converted to Forest Land estimates in this Inventory are based on the land use change information in the annual NFI. All conversions are based on empirical estimates compiled using plot remeasurements from the NFI, IPCC (2006) default biomass C stocks removed from Croplands and Grasslands in the year of conversion on individual plots and the Tier 2 method for estimating mineral soil C stock changes (Ogle et al. 2003, 2006; IPCC 2006). Overall, the Land Converted to Forest Land C stock changes decreased by an average of 10.4 percent (11.5 MMT CO_2 Eq.) over the time series. This decrease is directly attributed to the incorporation of the most recent annual NFI data into the compilation system.

- *Incineration of Waste (CO_2).* Revisions in municipal solid waste (MSW) incineration tonnages were made to the current inventory year to combine MSW tonnage data sources across the time series, including BioCycle's State of Garbage in America (van Haaren et al. 2010) and Shin (2014), U.S. Energy Information Administration (EIA 2019b) and St. Louis Federal Reserve's Economic Data (FRED) (EIA 2019b), *Advancing Sustainable Materials Management: Facts and Figures Report* (EPA 2019a), the Energy Recovery Council's 2018 Directory of Waste to Energy Facilities (ERC 2018), and EPA's Greenhouse Gas Reporting Program (GHGRP) (EPA 2020b). EPA also revised the existing methodology to use an aggregate carbon content per

ton of MSW incinerated based on carbon content, discard and incineration rates of individual fossil MSW components consistent with IPCC methodology. These changes resulted in an average annual increase of 6.1 MMT CO_2 Eq. (55.7 percent) of emissions from incineration of waste across the time series.

- *Natural Gas Systems (CH_4).* EPA received information and data related to the emission estimates through GHGRP reporting, the annual Inventory formal public notice periods, stakeholder feedback on updates under consideration, and new studies. EPA thoroughly evaluated relevant information available and made several updates to the Inventory, including using revised emission factors and produced water volumes to calculate produced water emissions (production segment), and using GTI 2019 along with GTI 2009 study data to calculate customer meter emissions (distribution segment). In addition, certain sources did not undergo methodological updates, but CH_4 estimates changed by greater than 0.05 MMT CO_2 Eq., comparing the previous estimate for 2018 to the current (recalculated) estimate for 2018. Those emissions changes were mostly due to GHGRP data submission revisions. Overall, the changes resulted in an average annual increase of 5.8 MMT CO_2 Eq. (3.8 percent) in methane emissions from natural gas systems.

- *Wastewater Treatment (CH_4).* EPA revised the domestic wastewater CH_4 methodology based on the *2019 Refinement* (IPCC 2019): added a correction factor to account for organics from industrial and commercial contributions to publicly owned treatment works POTWs (1.25); updated the emission factor for centralized aerobic systems which accounts for loss of dissolved methane formed with in the collection system (from 0 to 0.018 kg CH_4/kg BOD); revised the estimate of organics removed with sludge from POTWs; added emission estimates from discharge of domestic wastewater to aquatic environments based on type of receiving water (e.g., reservoir, lake, estuaries); and updated wastewater treatment activity data to align with the updates to organics removed and emissions from discharge to aquatic environments (ERG 2020). All these changes affected the time series from 1990 through 2018. Domestic wastewater treatment and discharge CH_4 emissions increased an average of 43 percent over the time series. These changes resulted in an average annual increase of 4.6 MMT CO_2 Eq. (30.1 percent) in methane emissions from wastewater treatment across the time series. The Industrial wastewater CH_4 methodology was also revised based on the based on the *2019 Refinement* (IPCC 2019) as described in Chapter 7, and contributed to recalculation impacts, but had smaller impacts, i.e., averaging a 7.7 percent increase over the time series.

- *Gasoline and Diesel Fuel Fossil Fuel Combustion (CO_2)*. EPA revised distillate fuel oil and motor gasoline carbon contents, which impacted petroleum emissions in the transportation, residential, commercial, and industrial sectors. The combined effect of both the diesel fuel and gasoline emission factor update was an increase in emissions early in the time series and then decreases in emissions in more recent years. For years 1990 through 2005, the average annual increase in total emissions was 6.9 MMT CO_2 (0.1 percent of emissions). For the years 2006 to 2018 the average annual decrease in total emissions is 4.7 MMT CO_2 (less than 0.1 percent of emissions).

- *Mobile Combustion (CH_4).* Updates were made to CH_4 and N_2O emission factors for newer non-road gasoline and diesel vehicles. Previously, these emission factors were calculated using the updated IPCC (2006) Tier 3 guidance and the nonroad component EPA's MOVES2014b model. CH_4 emission factors were calculated directly from MOVES. Updated emission factors were developed this year using EPA engine certification data for non-road small and large spark-ignition (SI) gasoline engines and compression-ignition diesel engines (2011 and newer), as well as non-road motorcycles (2006 and newer), SI marine engines (2011 and newer), and diesel marine engines (2000 and newer). The result of these changes was a net decrease in CH_4 emissions from mobile combustion relative to the previous Inventory. Methane emissions from mobile combustion decreased by an average of 4.5 MMT CO_2 Eq. (47.9 percent) throughout the time series.

- *Mobile Combustion (N_2O).* Updates were made to CH_4 and N_2O emission factors for newer non-road gasoline and diesel vehicles. Previously, these emission factors were calculated using the updated IPCC (2006) Tier 3 guidance and the nonroad component EPA's MOVES2014b model. N_2O emission factors are calculated using MOVES-Nonroad activity and emission factors in g/kWh by fuel type from the European

Environment Agency. Updated emission factors were developed this year using EPA engine certification data for non-road small and large spark-ignition (SI) gasoline engines and compression-ignition diesel engines (2011 and newer), as well as non-road motorcycles (2006 and newer), SI marine engines (2011 and newer), and diesel marine engines (2000 and newer). The result of these changes was an increase in N_2O emissions from mobile combustion relative to the previous Inventory. Nitrous oxide emissions from mobile combustion increased by 3.9 MMT CO_2 Eq. (12.5 percent) throughout the time series.

- *Fossil Fuel Combustion (CO_2).* The EIA (2020c) updated energy consumption statistics across the time series relative to the previous Inventory. As a result of revised natural gas heat contents, EIA updated natural gas consumption in the residential, commercial, and industrial sectors for 2018. Approximate heat rates for electricity and the heat content of electricity were revised for natural gas and noncombustible renewable energy, which impacted electric power energy consumption by sector. EIA also revised sector allocations for distillate fuel oil, residual fuel oil, and kerosene for 2018, and for propane for 2010 through 2012, 2014, 2017, and 2018, which impacted LPG by sector. EIA revised product supplied totals for crude oil and petroleum products, which impacted the nonfuel sequestration statistics, particularly for lubricants for 2018 and LPG for 2010 through 2018 relative to the previous Inventory. These changes resulted in an average annual decrease 3.4 MMT CO_2 Eq. (0.1 percent) in CO_2 emissions from fossil fuel combustion for the period 1990 through 2018, relative to the previous Inventory.

Finally, in addition to the more significant methodological updates noted above, the Inventory includes new categories not included in the previous Inventory that improve completeness of the national estimates. Specifically, the current report includes methane emissions from anaerobic digestion at biogas facilities, N_2O emissions from industrial wastewater, CF_4 emissions from Low Voltage Anode Effect (LVAE) during aluminum production and change in carbon stocks for belowground biomass in managed coastal wetlands.

Figure 9-1: Impacts from Recalculations to U.S. Greenhouse Gas Emissions by Sector

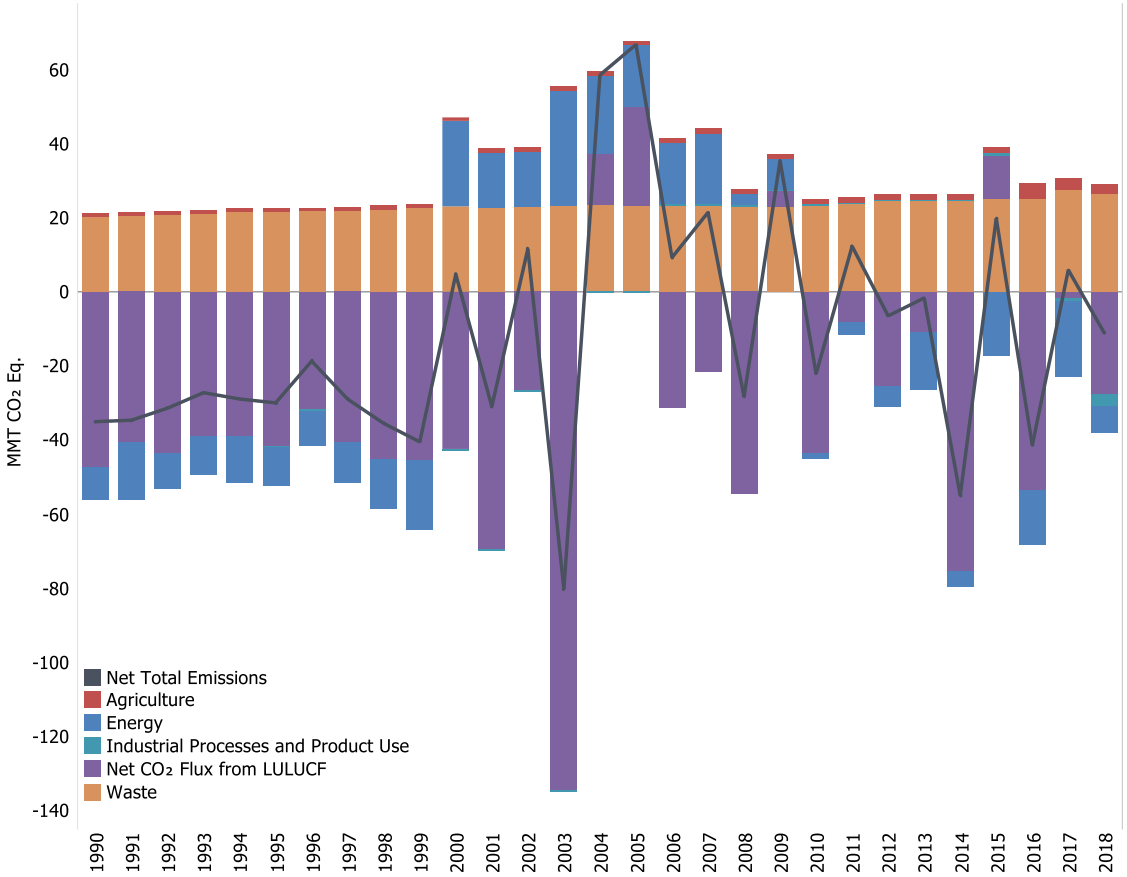

Table 9-1: Revisions to U.S. Greenhouse Gas Emissions (MMT CO_2 Eq.)

Gas/Source	1990	2005	2015	2016	2017	2018	Average Annual Change
CO_2	**(11.7)**	**9.1**	**(28.2)**	**(29.7)**	**(34.2)**	**(27.6)**	**(9.0)**
Fossil Fuel Combustion	(8.5)	13.2	(17.9)	(20.4)	(21.9)	(8.7)	(3.4)
Electric Power Sector	NC	0.1	+	+	+	0.1	+
Transportation	+	12.6	25.2	32.0	25.4	0.5	15.5
Industrial	(3.2)	(6.1)	(10.9)	(14.4)	(11.0)	4.8	(9.9)
Residential	0.4	1.2	0.3	(0.8)	0.8	2.3	0.6
Commercial	0.1	(0.8)	(20.6)	(21.9)	(20.5)	0.4	(3.6)
U.S. Territories	(5.8)	6.3	(12.0)	(15.2)	(16.6)	(16.8)	(6.0)
Non-Energy Use of Fuels	(6.8)	(9.1)	(21.7)	(20.1)	(23.4)	(23.7)	(11.8)
Natural Gas Systems	(0.1)	(0.1)	(0.2)	0.2	0.8	(1.1)	(0.1)
Cement Production	NC	NC	NC	NC	NC	(1.4)	+
Lime Production	NC	NC	+	(0.1)	+	(0.1)	+
Other Process Uses of Carbonates	NC	NC	NC	0.5	+	(2.5)	(0.1)
Glass Production	NC	NC	NC	+	+	+	+
Soda Ash Production	NC	NC	NC	NC	NC	NC	NC
Carbon Dioxide Consumption	NC	NC	0.5	0.2	0.1	(0.3)	+
Incineration of Waste	3.2	5.0	10.7	10.9	10.2	9.8	6.1
Titanium Dioxide Production	NC	NC	NC	NC	NC	NC	NC

Aluminum Production	NC	NC	+	NC	NC	NC	+
Iron and Steel Production & Metallurgical Coke Production	+	+	+	+	+	+	+
Ferroalloy Production	NC	NC	NC	NC	NC	NC	NC
Ammonia Production	NC	+	+	(0.6)	(2.1)	(1.4)	(0.1)
Urea Consumption for Non-Agricultural Purposes	NC	NC	NC	NC	1.2	2.4	0.1
Phosphoric Acid Production	NC	NC	NC	NC	NC	NC	NC
Petrochemical Production	NC	NC	NC	NC	NC	(0.1)	+
Carbide Production and Consumption	+	+	+	+	+	+	+
Lead Production	NC	NC	NC	NC	NC	NC	NC
Zinc Production	NC	NC	+	+	(0.1)	+	+
Petroleum Systems	0.1	(0.1)	(0.2)	(1.1)	0.3	(0.2)	(0.1)
Abandoned Oil and Gas Wells	NC	NC	NC	NC	NC	NC	NC
Magnesium Production and Processing	NC	NC	NC	NC	NC	NC	NC
Liming	NC	NC	NC	NC	NC	(0.9)	+
Urea Fertilization	0.4	0.4	0.6	0.8	0.5	0.6	0.5
International Bunker Fuels[a]	+	+	(0.1)	(0.1)	(0.1)	(0.1)	+
Wood Biomass, Ethanol, and Biodiesel Consumption[b]	NC	NC	NC	(0.6)	(9.9)	(9.3)	(0.7)
CH_4[c]	**5.6**	**8.5**	**13.6**	**19.3**	**18.9**	**21.4**	**9.6**
Stationary Combustion	+	+	(0.1)	(0.2)	(0.2)	(0.1)	+
Mobile Combustion	(6.6)	(5.7)	(1.0)	(0.9)	(0.8)	(0.7)	(4.5)
Coal Mining	NC	1.6	0.6	0.5	0.6	0.7	0.7
Abandoned Underground Coal Mines	NC	NC	NC	NC	NC	NC	NC
Natural Gas Systems	4.4	5.6	6.7	10.9	8.4	10.9	5.8
Petroleum Systems	2.4	1.8	2.5	1.8	2.2	2.3	2.0
Abandoned Oil and Gas Wells	NC	NC	NC	NC	NC	NC	NC
Petrochemical Production	NC	NC	NC	NC	NC	NC	NC
Carbide Production and Consumption	NC	NC	NC	NC	NC	NC	NC
Iron and Steel Production & Metallurgical Coke Production	NC	NC	NC	NC	NC	NC	NC
Ferroalloy Production	NC	NC	NC	NC	NC	NC	NC
Enteric Fermentation	0.5	0.4	0.4	0.4	0.4	0.4	0.4
Manure Management	NC	NC	NC	NC	NC	NC	NC
Rice Cultivation	NC	NC	NC	2.3	2.1	2.2	0.2
Field Burning of Agricultural Residues	+	+	+	+	+	+	+
Landfills	NC	0.1	0.1	+	1.7	1.5	0.2
Wastewater Treatment	4.8	4.6	4.3	4.3	4.3	4.2	4.6
Composting	NC	NC	NC	NC	NC	(0.2)	+
Anaerobic Digestion at Biogas Facilities	NC*	NC*	NC*	NC*	NC*	NC*	NC*
Incineration of Waste	+	+	+	+	+	+	+
International Bunker Fuels[a]	NC	NC	NC	NC	NC	NC	NC
N_2O[c]	**18.5**	**23.6**	**24.6**	**25.0**	**25.4**	**25.1**	**22.6**
Stationary Combustion	+	+	(0.1)	(0.1)	(0.2)	(0.1)	(0.1)
Mobile Combustion	3.2	4.7	3.5	3.7	3.9	3.9	3.9
Adipic Acid Production	NC	NC	NC	NC	NC	NC	NC
Nitric Acid Production	NC	NC	NC	NC	NC	0.2	+
Manure Management	NC	NC	NC	NC	NC	NC	NC
Agricultural Soil Management	+	0.3	0.4	0.3	0.2	0.1	0.2
Field Burning of Agricultural Residues	+	+	+	+	+	+	+
Wastewater Treatment	15.3	18.6	20.6	21.0	21.4	21.1	18.5
N_2O from Product Uses	NC	NC	NC	NC	NC	NC	NC
Caprolactam, Glyoxal, and Glyoxylic Acid Production	NC	NC	NC	NC	NC	NC	NC
Incineration of Waste	+	+	0.1	0.1	0.1	0.1	+

Composting	NC	NC	NC	NC	NC	(0.2)	+
Electronics Industry	NC	NC	+	+	+	+	+
Natural Gas Systems	+	+	+	+	+	+	+
Petroleum Systems	+	+	+	+	+	+	+
International Bunker Fuels[a]	NC	NC	NC	NC	NC	NC	NC
HFCs, PFCs, SF_6 and NF_3	**+**	**(1.1)**	**(2.1)**	**(2.4)**	**(2.3)**	**(2.4)**	**(1.0)**
HFCs	**NC**	**(1.1)**	**(2.2)**	**(2.4)**	**(2.4)**	**(2.3)**	**(1.0)**
Substitution of Ozone Depleting Substances[d]	NC	(1.1)	(2.2)	(2.4)	(2.3)	(2.3)	(1.0)
HCFC-22 Production	NC	NC	NC	NC	NC	NC	NC
Electronics Industry	NC	+	+	+	+	+	+
Magnesium Production and Processing	NC	NC	NC	NC	+	+	+
PFCs	**NC**	**+**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Aluminum Production	NC	NC	0.1	0.1	0.1	0.1	0.1
Electronics Industry	NC	+	+	+	+	+	+
Substitution of Ozone Depleting Substances[d]	NC	NC	NC	NC	NC	NC	NC
SF_6	**NC**	**+**	**+**	**+**	**+**	**(0.2)**	**+**
Electrical Transmission and Distribution	NC	NC	+	+	+	(0.2)	+
Electronics Industry	NC	+	+	+	+	+	+
Magnesium Production and Processing	NC	NC	NC	NC	+	+	+
NF_3	**NC**	**+**	**+**	**+**	**+**	**+**	**+**
Electronics Industry	NC	+	+	+	+	+	+
Unspecified Mix of HFCs, NF_3, PFCs and SF_6	**+**	**+**	**+**	**+**	**+**	**+**	**+**
Electronics Industry	+	+	+	+	+	+	+
Net Emissions (Sources and Sinks)	**(35.0)**	**40.1**	**7.9**	**12.2**	**7.8**	**16.6**	**22.1**
Percent Change	**-0.6%**	**1.0%**	**0.3%**	**-0.7%**	**0.1%**	**-0.2%**	**-0.2%**

Notes: Net change in total emissions presented without LULUCF. Totals may not sum due to independent rounding

NC (No Change)

+ Absolute value does not exceed 0.05 MMT CO_2 Eq. or 0.05 percent.

* Indicates a new source for the current Inventory year. Emissions from new sources are captured in net emissions and percent change totals.

[a] Emissions from International Bunker Fuels are not included in totals.

[b] Emissions from Wood Biomass, Ethanol, and Biodiesel Consumption are not included specifically in summing Energy sector totals. Net carbon fluxes from changes in biogenic carbon reservoirs are accounted for in the estimates for Land Use, Land-Use Change, and Forestry.

[c] LULUCF emissions of CH_4 and N_2O are reported separately from gross emissions totals in Table 9-2. LULUCF emissions include the CH_4, and N_2O emissions from *Peatlands Remaining Peatlands*; CH_4 and N_2O emissions reported for Non-CO_2 Emissions from Forest Fires, Non-CO_2 Emissions from Grassland Fires, and *Coastal Wetlands Remaining Coastal Wetlands*; CH_4 emissions from Land Converted to Coastal Wetlands; and N_2O emissions from Forest Soils and Settlement Soils.

[d] Small amounts of PFC emissions also result from this source.

Table 9-2: Revisions to U.S. Greenhouse Gas Emissions and Removals (Net Flux) from Land Use, Land-Use Change, and Forestry (MMT CO_2 Eq.)

Land-Use Category	1990	2005	2015	2016	2017	2018	Average Annual Change
Forest Land Remaining Forest Land	**(53.7)**	**17.1**	**4.8**	**(64.0)**	**(12.5)**	**(38.5)**	**(42.8)**
Changes in Forest Carbon Stocks[a]	(53.7)	17.1	4.7	(64.0)	(12.0)	(35.4)	(42.7)
Non-CO_2 Emissions from Forest Fires[b]	+	+	+	+	(0.5)	(3.1)	(0.1)
N_2O Emissions from Forest Soils[c]	NC	NC	NC	NC	NC	NC	NC
Non-CO_2 Emissions from Drained Organic Soils[d]	NC	NC	NC	NC	NC	NC	NC
Land Converted to Forest Land	**11.3**	**11.5**	**11.6**	**11.6**	**11.5**	**11.5**	**11.5**
Changes in Forest Carbon Stocks[e]	11.3	11.5	11.6	11.6	11.5	11.5	11.5
Cropland Remaining Cropland	**NC**	**NC**	**NC**	**+**	**+**	**+**	**+**

Changes in Mineral and Organic Soil Carbon Stocks	NC	NC	NC	+	+	+	+
Land Converted to Cropland	**(2.3)**	**(1.7)**	**(1.1)**	**(1.1)**	**(1.1)**	**(1.1)**	**(1.7)**
Changes in all Ecosystem Carbon Stocks[f]	(2.3)	(1.7)	(1.1)	(1.1)	(1.1)	(1.1)	(1.7)
Grassland Remaining Grassland	**(0.8)**	**(0.7)**	**(0.5)**	**0.2**	**0.4**	**0.5**	**(0.6)**
Changes in Mineral and Organic Soil Carbon Stocks	(0.8)	(0.7)	(0.5)	0.2	0.4	0.5	(0.6)
Non-CO_2 Emissions from Grassland Fires[g]	NC	NC	+	+	+	+	+
Land Converted to Grassland	**0.4**	**0.2**	**(0.8)**	**0.7**	**0.5**	**0.5**	**0.2**
Changes in all Ecosystem Carbon Stocks[f]	0.4	0.2	(0.8)	0.7	0.5	0.5	0.2
Wetlands Remaining Wetlands	**(3.0)**	**(0.6)**	**(3.2)**	**(3.2)**	**(3.1)**	**(3.0)**	**(1.3)**
Changes in Organic Soil Carbon Stocks in Peatlands	NC	NC	NC	NC	0.1	0.1	+
Changes in Aboveground and Soil Carbon Stocks in Coastal Wetlands	(3.3)	(0.9)	(3.4)	(3.4)	(3.4)	(3.4)	(1.6)
CH_4 Emissions from Coastal Wetlands Remaining Coastal Wetlands	0.3	0.3	0.2	0.2	0.2	0.2	0.3
N_2O Emissions from Coastal Wetlands Remaining Coastal Wetlands	NC	NC	+	+	+	+	+
Non-CO_2 Emissions from Peatlands Remaining Peatlands	NC	NC	NC	NC	+	+	+
Land Converted to Wetlands	**0.7**	**0.7**	**0.2**	**0.2**	**0.2**	**0.2**	**0.6**
Changes in Aboveground and Soil Carbon Stocks	0.5	0.5	+	+	+	+	0.4
CH_4 Emissions from Land Converted to Coastal Wetlands	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Settlements Remaining Settlements	**NC**	**NC**	**0.9**	**1.9**	**2.2**	**2.3**	**0.3**
Changes in Organic Soil Carbon Stocks	NC	NC	NC	+	+	+	+
Changes in Settlement Tree Carbon Stocks	NC	NC	NC	NC	NC	NC	NC
Changes in Yard Trimming and Food Scrap Carbon Stocks in Landfills	NC	NC	0.9	1.9	2.2	2.3	0.3
N_2O Emissions from Settlement Soils[h]	NC	NC	NC	NC	NC	NC	NC
Land Converted to Settlements	**NC**	**NC**	**NC**	**+**	**+**	**+**	**+**
Changes in all Ecosystem Carbon Stocks[f]	NC	NC	NC	+	+	+	+
LULUCF Emissions[i]	**0.5**	**0.5**	**0.5**	**0.4**	**(0.1)**	**(2.7)**	**0.4**
LULUCF Total Net Flux[j]	**(48.0)**	**26.1**	**11.5**	**(54.0)**	**(1.8)**	**(25.0)**	**(34.3)**
LULUCF Sector Total[k]	**(47.4)**	**26.6**	**11.9**	**(53.6)**	**(1.9)**	**(27.7)**	**(33.9)**
Percent Change	**-5.6%**	**3.3%**	**1.5%**	**-6.8%**	**-0.2%**	**-3.6%**	**-4.3%**

Note: Totals may not sum due to independent rounding

NC (No Change)

+ Absolute value does not exceed 0.05 MMT CO_2 Eq. or 0.05 percent.

[a] Includes the net changes to carbon stocks stored in all forest ecosystem pools and harvested wood products.

[b] Estimates include emissions from fires on both *Forest Land Remaining Forest Land* and *Land Converted to Forest Land.*

[c] Estimates include emissions from N fertilizer additions on both *Forest Land Remaining Forest Land* and *Land Converted to Forest Land*.

[d] Estimates include emissions from drained organic soils on both *Forest Land Remaining Forest Land* and *Land Converted to Forest Land.*

[e] Includes the net changes to carbon stocks stored in all forest ecosystem pools.

[f] Includes changes in mineral and organic soil carbon stocks for all land use conversions to cropland, grassland, and settlements, respectively. Also includes aboveground/belowground biomass, dead wood, and litter carbon stock changes for conversion of forest land to cropland, grassland, and settlements, respectively.

[g] Estimates include emissions from fires on both *Grassland Remaining Grassland* and *Land Converted to Grassland.*

[h] Estimates include emissions from N fertilizer additions on both *Settlements Remaining Settlements* and *Land Converted to Settlements* because it is not possible to separate the activity data at this time.

[i] LULUCF emissions include the CH_4 and N_2O emissions reported for Peatlands Remaining Peatlands, Forest Fires, Drained Organic Soils, Grassland Fires, and Coastal Wetlands Remaining Coastal Wetlands; CH_4 emissions from Land Converted to Coastal Wetlands; and N_2O emissions from Forest Soils and Settlement Soils.

[j] LULUCF Carbon Stock Change includes any C stock gains and losses from all land use and land use conversion categories.

[k] The LULUCF Sector Net Total is the net sum of all LULUCF CH_4 and N_2O emissions to the atmosphere plus net carbon stock changes.

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