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, 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."

The results of all methodological changes and historical data updates made in the current Inventory are presented in Table 9-1 and Table 9-2. To understand the details of any specific recalculation or methodological improvement, see the *Recalculations Discussion* within each source/sink categories' section found in Chapters 3 through 7 of this report and a discussion of Inventory improvements in Annex 8. Table 9-1 summarizes the quantitative effect of all changes on U.S. greenhouse gas emissions in the Energy, IPPU, Agriculture, and Waste sectors, while Table 9-2 summarizes the quantitative effect of changes on annual net fluxes from LULUCF. Both tables present results relative to the previously published Inventory (i.e., the 1990 to 2016 report) in units of million metric tons of carbon dioxide equivalent (MMT CO_2 Eq.).

In general, when methodological changes have been implemented, the previous Inventory's time series (i.e., 1990 to 2016) 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 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).* In the current Inventory the regional approach for carbon stock and stock change estimation in the western United States was replaced by the state-level method used in the eastern United States so carbon stocks and stock changes are now estimated consistently for the entire 1990 to 2017 time series in all states with remeasurements in the national forest inventory (NFI) in the conterminous 48 states. This improvement in consistency also improved separation of F*orest Land Remaining Forest Land*, *Land Converted to Forest Land*, and areas with perennial woody biomass that do not meet the definition of forest land (i.e., woodlands) that are now included in the *Grassland Remaining Grassland* and *Land Converted to Grassland* sections. Next, all managed forest land in Alaska, specifically forest land from interior Alaska, was also included for the first time in this Inventory, which added more than 24.5 million ha to the *Forest Land Remaining Forest Land* category. The inclusion of 24.5 million ha of forest area from interior Alaska contributed an additional 8,597 MMT C stocks, primarily from soil carbon, to the *Forest Land Remaining Forest Land* category in 2018 and this increase was consistent with the additions from interior Alaska over the time series (see Table 6-15). The carbon stock changes in interior Alaska were driven, in large part, by wildfires over the time series and contribute, on average over the time series, approximately -2.2 MMT C per year to the sink. As a result of these improvements, the estimates reported in the previous (i.e., 1990 through 2016) Inventory are not directly comparable to the estimates in this Inventory. In most cases this was not a loss of forest land area but rather a reorganization of land into the *Land Converted to Forest Land* category and the

transfer of 23.5 million hectares of land into the *Grassland Remaining Grassland* and *Land Converted to Grassland* categories. The recalculations resulted in an average annual increase in C stock change losses of 39.1 MMT CO_2 Eq. (6 percent), across the 1990 through 2016 time series, relative to the previous Inventory.

- *Land Converted to Cropland: Changes in all Ecosystem Carbon Stocks (CO_2).* Methodological recalculations are associated with extending the time series from 2013 through 2016 for mineral and organic soils using a surrogate data method, and from 1990 to 2016 for biomass and dead organic matter C associated with *Forest Land Converted to Cropland*. The increased C stock losses are almost entirely attributed to the update of biomass and dead organic matter losses for *Forest Land Converted to Cropland* with newly available re-measurement data for the western United States. Stock changes were re-estimated at the plot-level with the new data consistent with the compilation methods described for *Forest Land Remaining Forest Land*. In the previous Inventory, state-level averages from the plot data had been used to approximate the losses of C with *Forest Land Converted to Cropland* due to a lack of re-measurement data. C stock change losses increased by an average of 39.1 MMT CO_2 Eq. (141 percent) from 1990 through 2016 as a result of the recalculation, relative to the previous Inventory.
- *Settlements Remaining Settlements: Changes in Settlement Tree Carbon Stocks (CO_2).* Past estimates of C sequestration in settlement areas used urban land and urban tree cover as proxy for the settlement area estimates. This new approach uses settlement land area and percent tree cover in developed land as a proxy for percent tree cover in settlement area. The recalculations resulted in an average annual increase in C stock gains of 35.7 MMT CO_2 Eq. (47 percent), across the 1990 through 2016 time series, relative to the previous Inventory.
- *Land Converted to Forest Land: Changes in Forest Carbon Stocks (CO_2).* The availability of remeasurement data from the annual national forest inventory (NFI) allowed for consistent plot-level estimation of C stocks and stock changes for *Forest Land Remaining Forest Land* and the *Land Converted to Forest Land* categories. Estimates in the current Inventory were based on state-level carbon density estimates and a combination of Natural Resources Inventory (NRI) data and NFI data in the eastern United States. The refined analysis in this Inventory resulted in changes in the *Land Converted to Forest Land* categories. The recalculations resulted in an average annual increase in C stock gains of 30.4 MMT CO_2 Eq. (37 percent), across the 1990 through 2016 time series, relative to the previous Inventory.
- *Land Converted to Settlements: Changes in Settlement Soil Carbon Stocks (CO_2).* Methodological recalculations are associated with extending the time series from 2013 through 2017 using a linear time series model, and an update of biomass and dead organic matter losses with *Forest Land Converted to Settlements*. The recalculation led to a 31 percent greater loss of C on average. This change is almost entirely attributed to the update of biomass and dead organic matter losses for *Forest Land Converted to Settlements* with newly available re-measurement data for the western United States. New stock changes were estimated at the plot-level with the new data consistent with the compilation methods described in the *Forest Land Remaining Forest Land* section. In the previous Inventory, state-level averages from the plot data had been used to approximate the losses of C with *Forest Land Converted to Settlements* due to a lack of re-measurement data. These changes resulted in an average annual increase in C stock change losses of 18.0 MMT CO_2 Eq. (31 percent) relative to the previous Inventory.
- *Stationary Combustion (N_2O).* Nitrous oxide emissions from stationary sources were revised across the entire time series due to revised data from EIA (2019) and EPA (2018) relative to the previous Inventory. Most notably, EIA updated wood biomass consumption statistics in the residential sector from 2009 to 2016, and the commercial sector from 2014 to 2016 (EIA 2019). Nitrous oxide emission factors for coal wall-fired boilers used in the electric power sector were also updated from 0.5 kg/TJ to 5.8 kg/TJ to be consistent with EPA's Compilation of Air Pollutant Emission Factors, AP-42 (EPA 1997). These changes resulted in an average annual increase in N_2O emissions of 15.3 MMT CO_2 Eq. (107 percent) relative to the previous Inventory.
- *Land Converted to Grassland: Changes in all Ecosystem Carbon Stock (CO_2).* Methodological recalculations are associated with extending the time series from 2013 through 2016 for mineral and organic soils using a surrogate data method, and from 1990 to 2016 for biomass and dead organic matter C associated with *Forest Land Converted to Grassland*. This change is almost entirely attributed to the update of biomass and dead organic matter losses for *Forest Land Converted to Grassland* with newly available

re-measurement data for the western United States. Stock changes were re-estimated at the plot-level with the new data consistent with the compilation methods described for *Forest Land Remaining Forest Land*. In the previous Inventory, state-level averages from the plot data had been used to approximate the losses of C with *Forest Land Converted to Grassland* due to a lack of remeasurement data. These changes resulted in an average annual increase in C stock of 14.3 MMT CO_2 Eq. (67 percent) relative to the previous Inventory.

- *Forest Land Remaining Forest Land: Non-CO_2 Emissions from Forest Fires (CO_2).* The methods used in the current Inventory to compile estimates of non-CO_2 emissions from forest fires are consistent with those used in the previous (i.e., 1990 through 2016) Inventory, but also include some additional steps toward better definition of forest area in Alaska, fuel, and combustion. Modifications in each of these factors affect estimates. Forest within the Monitoring Trends in Burn Severity (MTBS) defined fire perimeters (MTBS Data Summaries 2018) are estimated according to National Land Cover Dataset (NLCD) spatial datasets (Homer et al. 2015) rather than Ruefenacht et al. (2008) as in the previous report. Fuel estimates are based on the distribution of stand-level carbon pools (USDA Forest Service 2018b, 2018d) classified according to ecological region rather than the state-wide estimates as in the previous report. Combustion estimates are partly a function of the MTBS severity classifications and thus can vary within a fire. The effects of these modifications varied across the time series, but more often lowered the estimates for both CH_4 and N_2O. These changes resulted in an average annual decrease in CH_4 and N_2O emissions of 3.6 MMT CO_2 Eq. (28 percent) relative to the previous Inventory.
- *Wetlands Remaining Wetlands: Changes in Mineral and Organic Soil Carbon Stocks in Coastal Wetlands (CO_2).* Methodological recalculations are associated with the extension of the Coastal Change Analysis Program (C-CAP) data extrapolation through 2017. Soil reference carbon sequestration rates were updated based on recalculation by Lu and Megonigal (2017), which decreased net removals to soil by 0.01 MMT CO_2 Eq. per year. New data on aboveground biomass carbon stocks were added, broken down by climate zone, that were derived from a national assessment combining field plot data and aboveground biomass mapping by remote sensing (Byrd et al., 2017; Byrd, et al., 2018). These changes resulted in an average annual increase in C stock change losses of 3.5 MMT CO_2 Eq. (46 percent) relative to the previous Inventory.
- *Petroleum Systems (CH_4).* Updates were made to exploration and production segment methodologies, specifically: using GHGRP data to calculate emissions and activity factors for oil well completions and workovers with hydraulic fracturing; using DrillingInfo data (DrillingInfo 2018) to calculate well drilling activity; and revising the basis for calculating the number of active wells represented in GHGRP reporting. The combined impact of revisions to 2016 petroleum systems CH_4 emissions, compared to the previous Inventory, is a decrease from 38.6 to 38.2 MMT CO_2 Eq. (0.4 MMT CO_2 Eq., or 1 percent). The recalculations resulted in an average annual increase in CH_4 emission estimates across the 1990 through 2016 time series, compared to the previous Inventory, of 3.3 MMT CO_2 Eq. (10 percent) with the largest increases in the estimates for 2005 to 2013 due to the revised data on hydraulically fractured oil well completions.

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 inclusion of N_2O emissions from *Natural Gas Systems* and *Petroleum Systems,* and CO_2 emissions from petroleum transport in *Petroleum Systems,* and breweries as a source of CH_4 emissions from industrial wastewater within *Waste*.

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

Gas/Source	1990	2005	2013	2014	2015	2016	Average Annual Change
CO_2	**-0.1**	**-1.5**	**3.3**	**3.3**	**2.2**	**-4.2**	**-1.0**
Fossil Fuel Combustion	-1.6	-2.2	0.5	-1.0	-2.1	-4.2	-2.1
Transportation	*-0.9*	*-0.9*	*0.1*	*-0.9*	*+*	*-0.4*	*-0.6*
Electric Power Sector	*1.5*	*1.2*	*5.1*	*4.4*	*-1.5*	*-3.6*	*0.7*
Industrial	*-1.4*	*-2.3*	*-3.2*	*-5.4*	*-1.6*	*-1.5*	*-2.1*

Residential	*-0.2*	*0.1*	*-0.4*	*1.5*	*1.0*	*0.4*	*0.2*
Commercial	*-0.7*	*-0.3*	*-1.1*	*-0.7*	*+*	*0.9*	*-0.4*
U.S. Territories	*NC*	*+*	*+*	*+*	*+*	*+*	*+*
Non-Energy Use of Fuels	+	0.7	+	1.0	1.3	1.5	0.4
Natural Gas Systems	0.2	0.1	0.3	0.2	0.2	+	0.2
Cement Production	NC	NC	NC	NC	NC	NC	NC
Lime Production	NC	NC	NC	NC	NC	NC	NC
Other Process Uses of Carbonates	NC	NC	NC	NC	-0.1	+	+
Glass Production	NC	NC	NC	NC	NC	+	+
Soda Ash Production	NC	NC	NC	NC	NC	NC	NC
Carbon Dioxide Consumption	NC	NC	NC	NC	NC	NC	NC
Incineration of Waste	NC	NC	+	-0.2	0.1	0.1	+
Titanium Dioxide Production	NC	NC	NC	NC	NC	0.1	+
Aluminum Production	NC	NC	NC	NC	NC	NC	NC
Iron and Steel Production & Metallurgical Coke Production	NC	NC	NC	NC	+	+	+
Ferroalloy Production	NC	NC	NC	NC	NC	NC	NC
Ammonia Production	NC	NC	-0.5	-0.2	-0.2	-1.4	-0.1
Urea Consumption for Non-Agricultural Purposes	NC	NC	0.5	0.3	0.4	1.2	0.1
Phosphoric Acid Production	NC	NC	NC	NC	NC	+	+
Petrochemical Production	+	+	NC	NC	NC	NC	+
Silicon Carbide Production and Consumption	NC	NC	NC	NC	NC	NC	NC
Lead Production	NC	NC	NC	NC	NC	+	+
Zinc Production	NC	NC	NC	NC	NC	NC	NC
Petroleum Systems	1.3	-0.1	2.5	3.3	2.9	-0.6	0.6
Abandoned Oil and Gas Wells	+	+	+	+	+	+	+
Magnesium Production and Processing	NC	NC	NC	NC	NC	NC	NC
Liming	NC	NC	NC	NC	+	-0.7	+
Urea Fertilization	NC	NC	NC	+	-0.2	-0.2	+
Wood Biomass, Ethanol, and Biodiesel Consumption[a]	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
International Bunker Fuels[a]	*NC*	*NC*	*-0.9*	*-1.1*	*7.3*	*7.9*	*1.2*
CH_4	**-0.1**	**2.8**	**0.5**	**-1.9**	**-4.0**	**-2.5**	**1.1**
Stationary Combustion	+	+	+	+	0.6	0.6	0.1
Mobile Combustion	0.2	0.2	-0.2	-0.2	-0.2	-0.3	0.1
Coal Mining	NC	NC	NC	NC	NC	+	+
Abandoned Underground Coal Mines	NC	NC	NC	NC	NC	NC	NC
Natural Gas Systems	-2.1	2.3	1.8	0.8	0.9	2.2	0.6
Petroleum Systems	2.2	4.6	5.1	3.5	1.4	-0.4	3.3
Abandoned Oil and Gas Wells	0.1	0.1	+	+	+	0.1	0.1
Petrochemical Production	NC	NC	NC	NC	NC	NC	NC
Silicon 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	NC	NC	+	+	+	1.8	0.1
Manure Management	+	-2.6	-5.2	-5.1	-5.4	-6.2	-2.3
Rice Cultivation	NC	NC	NC	NC	NC	NC	NC
Field Burning of Agricultural Residues	-0.1	+	-0.1	-0.1	-0.1	-0.1	-0.1
Landfills	NC	-1.3	-0.3	-0.2	-0.5	0.3	-0.3
Wastewater Treatment	-0.4	-0.4	-0.6	-0.7	-0.6	-0.6	-0.4
Composting	NC	NC	NC	NC	+	+	+
Incineration of Waste	NC	NC	NC	NC	NC	NC	NC
International Bunker Fuels[a]	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
N_2O	**15.6**	**18.0**	**2.1**	**1.6**	**-5.5**	**-5.1**	**13.9**
Stationary Combustion	14.0	16.9	14.0	13.9	12.4	11.5	15.3
Mobile Combustion	0.3	0.2	-0.4	-0.4	-0.5	-0.5	+
Adipic Acid Production	NC	NC	NC	NC	NC	+	+

Nitric Acid Production	NC	NC	NC	NC	NC	+	+
Manure Management	NC	-0.1	-0.1	-0.1	-0.1	+	-0.1
Agricultural Soil Management	1.2	1.1	-11.4	-11.7	-17.2	-16.0	-1.3
Field Burning of Agricultural Residues	+	+	+	+	+	+	+
Wastewater Treatment	NC	+	+	-0.1	-0.1	-0.1	+
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	NC	NC	NC	NC	NC	NC	NC
Composting	NC	NC	NC	NC	+	+	+
Semiconductor Manufacture	NC	NC	+	+	+	+	+
Natural Gas Systems	NC*	NC*	NC*	NC*	NC*	NC*	NC*
Petroleum Systems	NC*	NC*	NC*	NC*	NC*	NC*	NC*
International Bunker Fuels[a]	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*	*NC*
HFCs, PFCs, SF_6 and NF_3	**+**	**-0.6**	**-4.8**	**-6.2**	**-7.1**	**-7.2**	**-1.6**
HFCs	**+**	**-0.6**	**-5.0**	**-6.1**	**-6.9**	**-7.4**	**-1.5**
Substitution of Ozone Depleting Substances	+	-0.6	-5.1	-6.1	-6.9	-7.4	-1.5
HCFC-22 Production	NC	NC	NC	NC	NC	NC	NC
Semiconductor Manufacture	NC	+	0.1	+	+	+	+
Magnesium Production and Processing	NC	NC	NC	NC	NC	NC	NC
PFCs	**NC**	**-0.1**	**0.2**	**+**	**+**	**+**	**+**
Aluminum Production	NC	NC	NC	NC	NC	NC	NC
Semiconductor Manufacture	NC	-0.1	0.2	+	+	+	+
Substitution of Ozone Depleting Substances	NC	NC	+	+	+	+	+
SF_6	**+**	**+**	**0.1**	**-0.1**	**-0.2**	**0.1**	**-0.1**
Electrical Transmission and Distribution	+	+	+	-0.1	-0.2	+	+
Semiconductor Manufacture	NC	+	0.3	+	+	+	+
Magnesium Production and Processing	NC	NC	-0.2	-0.1	0.1	0.1	-0.1
NF_3	**NC**	**+**	**-0.1**	**+**	**+**	**+**	**+**
Semiconductor Manufacture	NC	+	-0.1	+	+	+	+
Net Emissions (Sources and Sinks)[b]	**28.0**	**9.9**	**23.4**	**67.2**	**-30.2**	**-24.9**	**28.0**
Percent Change	**0.5%**	**0.1%**	**0.4%**	**1.1%**	**-0.5%**	**-0.4%**	**0.5%**

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] Not included in emissions total.

[b] Sinks are only included in net emissions total.

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	2013	2014	2015	2016	Average Annual Change
Forest Land Remaining Forest Land	**23.3**	**18.2**	**52.4**	**98.6**	**11.1**	**18.9**	**35.6**
Changes in Forest Carbon Stocks[a]	26.1	25.2	54.2	100.5	21.0	41.5	39.1
Non-CO_2 Emissions from Forest Fires[b]	-2.8	-7.0	-1.8	-1.9	-9.9	-22.6	-3.6
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	**-27.1**	**-38.4**	**-45.5**	**-45.5**	**-45.6**	**-45.6**	**-30.4**
Changes in Forest Carbon Stocks[e]	-27.1	-38.4	-45.5	-45.5	-45.6	-45.6	-30.4
Cropland Remaining Cropland	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
Changes in Mineral and Organic Soil Carbon Stocks	NC	NC	NC	NC	NC	NC	NC
Land Converted to Cropland	**32.3**	**40.8**	**43.7**	**43.6**	**43.6**	**43.6**	**39.1**
Changes in all Ecosystem Carbon Stocks[f]	32.3	40.8	43.7	43.6	43.6	43.6	39.1

Grassland Remaining Grassland	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**	**NC**
Changes in Mineral and Organic Soil Carbon Stocks	NC	NC	NC	NC	NC	NC	NC
Non-CO_2 Emissions from Grassland Fires[g]	NC	NC	NC	NC	NC	NC	NC
Land Converted to Grassland	**-9.1**	**-14.0**	**-13.6**	**-13.5**	**-13.5**	**-13.5**	**-14.3**
Changes in all Ecosystem Carbon Stocks[f]	-9.1	-14.0	-13.6	-13.5	-13.5	-13.5	-14.3
Wetlands Remaining Wetlands	**3.5**	**3.3**	**3.5**	**3.5**	**3.5**	**3.5**	**3.5**
Changes in Organic Soil Carbon Stocks in Peatlands	NC	NC	NC	NC	+	+	+
Changes in Aboveground and Soil Carbon Stocks in Coastal Wetlands	3.5	3.3	3.5	3.5	3.5	3.4	3.5
CH_4 Emissions from Coastal Wetlands Remaining Coastal Wetlands	+	+	+	+	+	+	+
N_2O Emissions from Coastal Wetlands Remaining Coastal Wetlands	NC	NC	NC	NC	NC	+	+
Non-CO_2 Emissions from Peatlands Remaining Peatlands	NC	NC	NC	NC	+	+	+
Land Converted to Wetlands	**+**	**+**	**+**	**+**	**+**	**+**	**+**
Changes in Aboveground and Soil Carbon Stocks	+	+	+	+	+	+	+
CH_4 Emissions from Land Converted to Coastal Wetlands	NC	NC	+	+	+	+	+
Settlements Remaining Settlements	**-35.9**	**-36.3**	**-36.1**	**-34.6**	**-33.2**	**-31.0**	**-35.8**
Changes in Organic Soil Carbon Stocks	NC	NC	NC	NC	NC	NC	NC
Changes in Settlement Tree Carbon Stocks	-35.8	-36.3	-36.1	-34.4	-32.7	-31.0	-35.7
Changes in Yard Trimming and Food Scrap Carbon Stocks in Landfills	+	-0.1	-0.1	-0.2	-0.5	0.1	-0.1
N_2O Emissions from Settlement Soils[h]	NC	NC	NC	NC	NC	NC	NC
Land Converted to Settlements	**25.7**	**17.7**	**18.0**	**18.4**	**18.4**	**18.4**	**18.0**
Changes in all Ecosystem Carbon Stocks[f]	25.7	17.7	18.0	18.4	18.4	18.4	18.0
LULUCF Emissions[i]	**-2.9**	**-7.0**	**-1.8**	**-1.9**	**-9.8**	**-22.6**	**-3.6**
LULUCF Carbon Stock Change[j]	**15.5**	**-1.9**	**24.1**	**72.2**	**-6.0**	**16.8**	**19.2**
LULUCF Sector Net Total[i]	**12.6**	**-8.9**	**22.3**	**70.4**	**-15.9**	**-5.8**	**15.6**
Percent Change	**1.5%**	**-1.2%**	**3.0%**	**9.5%**	**-2.3%**	**-0.8%**	**2.1%**

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 CH_4 and N_2O emissions to the atmosphere plus net carbon stock changes.