# 9. 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 made in the current Inventory report are presented in this section; detailed descriptions of each recalculation are contained within each source's description found in this report, if applicable. Table 9-1 summarizes the quantitative effect of these changes on U.S. greenhouse gas emissions and sinks and Table 9-2 summarizes the quantitative effect on annual net $CO_2$ fluxes, both relative to the previously published U.S. Inventory (i.e., the 1990 through 2013 report). These tables present the magnitude of these changes in units of million metric tons of carbon dioxide equivalent (MMT $CO_2$ Eq.).

The Recalculations Discussion section of each source's description in the respective chapter of this Inventory presents the details of each recalculation. In general, when methodological changes have been implemented, the entire time series (i.e., 1990 through 2013) 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 ten emission sources and sinks underwent some of the most significant methodological and historical data changes. These emission sources consider only methodological and historical data changes. A brief summary of the recalculations and/or improvements undertaken is provided for each of the ten sources.

- *Natural Gas Systems ($CH_4$).* EPA received information and data related to the emission estimates through the Inventory preparation process, previous Inventories' formal public notice periods, GHGRP data, and new studies. EPA carefully evaluated relevant information available, and made several updates, including revisions to production segment activity data, production segment pneumatic controller activity and emissions data, gathering and boosting facility emissions, transmission and storage station activity and emissions data, distribution segment emissions data for pipelines, distribution segment M&R station activity and emissions data, and distribution segment customer meter emissions data. From December 2015 through February 2016, the EPA released four draft memos that discussed the changes under consideration and requested stakeholder feedback on those changes. The impact of all revisions to natural gas systems is an average annual increase in emissions of 12.9 MMT $CO_2$ Eq. relative to the previous Inventory.
- *Petroleum Systems ($CH_4$).* The EPA received information and data related to the emission estimates through the Inventory preparation process, previous Inventories' formal public notice periods, EPA's Greenhouse Gas Reporting Program (GHGRP) data, and new studies. The EPA carefully evaluated relevant information available, and made revisions to the production segment methodology for the 2016 Inventory including revised equipment activity data, revised pneumatic controller activity and emissions data, and included a separate estimate for hydraulically fractured oil completions, which were previously not estimated as a distinct subcategory of oil well completions. All these changes resulted in an average annual increase in emissions of 20.7 MMT $CO_2$ Eq. relative to the previous Inventory.

- *Landfills ($CH_4$).* Four major methodological recalculations were performed for the current Inventory. First, a rigorous review of the flare and landfill gas-to-energy (LFGTE) projects across the four recovery databases was conducted. Extensive corrections were made to avoid double counting of projects across the recovery databases. Additionally, several facilities in the LFGTE database were removed because they were not in the published LMOP database for the current or past two years (EPA 2015). Second, the GHGRP $CH_4$ recovery data were back-calculated for landfills in the GHGRP database for years prior to the first GHGRP reporting year (typically 2010 for most landfills). Third, the flare correction factor was revised. Fourth, the DOC value for landfilled pulp and paper waste was revised from 0.20 to 0.15 based a literature review of pulp and paper waste characterization studies (RTI 2015) and data reported under the GHGRP. The overall impact to the Inventory from these changes resulted in an average increase of nearly 14 percent across the time series. A significant increase in net $CH_4$ emissions for the years 2010 through 2013 ranging from 20 to 52 percent higher in the current inventory compared to the 1990 to 2013 inventory. These changes resulted in an average annual decrease in emissions of 6.4 MMT $CO_2$ Eq. relative to the previous Inventory.
- *Agricultural Soil Management ($N_2O$).* Methodological recalculations in the current Inventory are associated with the following improvements: (1) driving the DAYCENT simulations with updated input data for land management from the National Resources Inventory extending the time series through 2010; (2) accounting for N inputs from residues associated with additional crops not simulated by DAYCENT including most vegetable crops; (3) modifying the number of experimental study sites used to quantify model uncertainty for direct $N_2O$ emissions; and (4) using DAYCENT for direct $N_2O$ emissions from most flooded rice lands, instead of using the Tier 1 approach for all rice lands. These changes resulted in an increase in emissions of approximately 24 percent on average relative to the previous Inventory and a decrease in the upper bound of the 95 percent confidence interval for direct $N_2O$ emissions from 26 to 24 percent. The differences in emissions and uncertainty are mainly due to increasing the number of study sites used to quantify model uncertainty. These changes resulted in an average annual increase in emissions of 60.1 MMT $CO_2$ Eq. relative to the previous Inventory.
- *Land Converted to Grassland - Changes in Agricultural Soil Carbon Stocks ($CO_2$).* Methodological recalculations in the current Inventory are associated with the following improvements, including: (1) incorporation of updated NRI data for 1990 through 2010; (2) inclusion of federal grasslands in the Tier 2 analysis; (3) improving the simulation of hydric soils in DAYCENT, and (4) incorporating the aboveground biomass C stock losses with Forest Land Converted to Grassland. These changes resulted in an average annual increase in emissions of 49.0 MMT $CO_2$ Eq. relative to the previous Inventory.
- *Land Converted to Cropland - Changes in Agricultural Carbon Stocks ($CO_2$).* Methodological recalculations in the current Inventory are associated with the following improvements: (1) incorporation of updated NRI data for 1990 through 2010; (2) inclusion of federal croplands; (3) improving the simulation of hydric soils in DAYCENT, and (4) incorporating the aboveground biomass C stock losses with Forest Land Converted to Cropland. These changes in SOC stocks resulted in an average annual decrease in emissions of 21.8 MMT $CO_2$ Eq. relative to the previous Inventory.
- *Cropland Remaining Cropland - Changes in Agricultural Carbon Stocks ($CO_2$ sink).* Methodological recalculations in the current Inventory are associated with the following improvements: (1) incorporation of updated NRI data for 1990 through 2010; and (2) inclusion of federal croplands; and (3) improving the simulation of hydric soil. These changes in SOC stocks resulted in an average annual decrease in sequestration of 16.5 MMT $CO_2$ Eq. relative to the previous Inventory.
- *Forest Land Remaining Forest Land - Changes in Forest Carbon Stock ($CO_2$ sink).* Forest ecosystem stock and stock-change estimates differ from the previous Inventory report principally due to the adoption of a new accounting framework (Woodall et al. 2015). The major differences between the framework used this year and past accounting approaches is the sole use of annual FIA data and the back-casting of forest C stocks across the 1990s based on forest C stock density and land use change information obtained from the nationally consistent annual forest inventory coupled with in situ observations of non-tree C pools such as soils, dead wood, and litter. The use of this accounting framework has enabled the creation of the two land use sections for forest C stocks: *Forest Land Remaining Forest Land* and *Land Converted to Forest Land*. In prior submissions (e.g., the 1990 through 2013 Inventory submission), the C stock changes from *Land Converted to Forest Land* were a part of the *Forest Land Remaining Forest Land* section and it was not possible to disaggregate the estimates. A second major change was the adoption of a new approach to estimate forest soil C, the largest C stock in the

United States. For detailed discussion of these new approaches please refer to the Methodology section, Annex 3.13, Domke et al. (in prep), and Woodall et al. (2015). In addition to these major changes, the refined land representation analysis described in Section 6.1 Representation of the U.S. Land Base which identifies some of the forest land in south central and southeastern coastal Alaska as unmanaged; this is in contrast to past assumptions of "managed" land for these forest lands included in the FIA database. Therefore, the C stock and flux estimates for southeast and south central coastal Alaska, as included here, reflect that adjustment, which effectively reduces the managed forest area by approximately 5 percent.

In addition to the creation of explicit estimates of removals and emissions by *Forest Land Remaining Forest Land* versus *Land Converted to Forest Land*, the accounting framework used this year eliminated the use of periodic data (which may be inconsistent with annual inventory data) which contributed to a data artifact in prior estimates of emissions/removals from 1990 to the present. In the previous Inventory report, there was a reduction in net sequestration from 1995 to 2000 followed by an increase in net sequestration from 2000 to 2004. This artifact of comparing inconsistent inventories of the 1980s through 1990s to the nationally consistent inventories of the 2000s has been removed in this Inventory. Overall, there were net C additions to HWP in use and in SWDS combined due, in large part, to updated data on products in use from 2010 to the present. All these changes resulted in an average annual increase in sequestration of 8.9 MMT $CO_2$ Eq. relative to the previous Inventory.

- *Substitution of Ozone Depleting Substances (HFCs).* For the current Inventory, reviews of the large retail food and refrigerated transport end-uses resulted in revisions to the Vintaging Model since the previous Inventory report. In addition, a vending machine end-use was added to the Vintaging Model since the previous Inventory. Methodological recalculations were applied to the entire time-series to ensure time-series consistency from 1990 through 2014. For the large retail food end-use, assumptions regarding new installations by system type and refrigerant transitions were revised based on a review of data collected by EPA's GreenChill Partnership and the California Air Resources Board's Refrigerant Management Program. Based on a literature review of technical reports and relevant datasets, the refrigerated transport end-use was updated from an aggregate end-use that covered all the various refrigerated transport modes through average assumptions of charge size, leak rates, stock, and lifetimes to separate end-uses by mode, including road transport, intermodal containers, merchant fishing, reefer ships, and vintage and modern rail. The vending machine end-use was added based on a review of technical reports and sales data. Combined, these assumption changes and additions decreased $CO_2$-equivalent greenhouse gas emissions on average by 5 percent between 1990 and 2014. Overall, these changes resulted in an average annual decrease in emissions of 6.3 MMT $CO_2$ Eq. relative to the previous Inventory.
- *Grassland Remaining Grassland - Changes in Agricultural Carbon Stock ($CO_2$ sink).* Methodological recalculations in the current Inventory are associated with the following improvements, including (1) incorporation of updated NRI data for 1990 through 2010; (2) inclusion of federal grasslands in the Tier 2 analysis; and (3) improving the simulation of hydric soils in DAYCENT. These changes in soil organic carbon (SOC) stocks resulted in an average annual increase in sequestration of 4.9 MMT $CO_2$ Eq. relative to the previous Inventory.

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

| Gas/Source | 1990 | 2005 | 2010 | 2011 | 2012 | 2013 | Average Annual Change |
|---|---|---|---|---|---|---|---|
| **$CO_2$** | **(8.6)** | **(11.2)** | **(15.8)** | **(9.4)** | **(9.1)** | **(2.6)** | **(10.2)** |
| Fossil Fuel Combustion | + | (0.5) | (8.9) | (3.7) | (1.3) | (0.1) | (1.1) |
| *Electricity Generation* | *NC* | *NC* | *NC* | *NC* | *NC* | *(1.6)* | *(0.1)* |
| *Transportation* | *NC* | *(0.8)* | *(3.7)* | *(3.9)* | *(4.0)* | *(5.4)* | *(1.5)* |
| *Industrial* | + | *0.2* | *(0.1)* | *(0.8)* | *(1.3)* | *(5.0)* | *(0.2)* |
| *Residential* | *NC* | + | *(0.1)* | *(0.4)* | *(0.6)* | *0.1* | + |
| *Commercial* | *NC* | + | *(0.1)* | *(0.3)* | *(0.4)* | *0.3* | + |
| *U.S. Territories* | *NC* | *NC* | *(4.8)* | *1.7* | *5.0* | *11.6* | *0.6* |
| Non-Energy Use of Fuels | 0.5 | + | (0.5) | 0.2 | 0.7 | 1.8 | 0.1 |
| Natural Gas Systems | 0.1 | 0.1 | 0.1 | 0.1 | 0.4 | 0.6 | 0.1 |
| Cement Production | NC | NC | NC | NC | NC | + | + |
| Lime Production | + | + | + | + | + | + | + |
| Other Process Uses of Carbonates | NC | NC | NC | NC | NC | 6.0 | 0.2 |
| Glass Production | NC | NC | NC | NC | NC | 0.2 | + |
| Soda Ash Production and Consumption | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Carbon Dioxide Consumption | NC | NC | 3.2 | 3.3 | 3.2 | 3.3 | 0.5 |
| Incineration of Waste | NC | NC | NC | NC | + | (0.7) | + |
| 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 | (0.1) | (0.1) | (0.1) | (0.1) | (0.1) | (0.1) | (0.1) |
| Ferroalloy Production | NC | NC | NC | NC | NC | NC | NC |
| Ammonia Production | NC | NC | NC | NC | NC | (0.2) | + |
| Urea Consumption for Non-Agricultural Purposes | NC | NC | NC | NC | NC | (0.5) | + |
| Phosphoric Acid Production | (0.1) | (0.1) | + | + | + | (0.1) | (0.1) |
| Petrochemical Production | + | (0.7) | (0.1) | (0.1) | + | (0.1) | (0.2) |
| Silicon Carbide Production and Consumption | NC | NC | NC | NC | NC | + | + |
| Lead Production | NC | NC | NC | NC | NC | + | + |
| Zinc Production | NC | NC | NC | NC | NC | NC | NC |
| Petroleum Systems | (0.9) | (1.0) | + | (0.3) | (1.2) | (2.3) | (0.9) |
| Magnesium Production and Processing | + | + | + | NC | NC | + | + |
| *Biomass – Wood*[a] | *NC* | *NC* | *NC* | *NC* | *NC* | *3.0* | *0.1* |
| *International Bunker Fuels*[a] | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* |
| *Biomass – Ethanol*[a] | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* |
| **$CH_4$**[b] | **28.4** | **9.5** | **55.2** | **56.5** | **66.8** | **85.2** | **21.3** |
| Stationary Combustion | + | + | + | + | + | + | + |
| Mobile Combustion | + | (0.3) | + | + | + | + | (0.1) |
| Coal Mining | NC | NC | NC | NC | NC | NC | NC |
| Abandoned Underground Coal Mines | NC | NC | NC | NC | NC | NC | NC |
| Natural Gas Systems | 27.6 | 1.0 | 6.6 | 10.8 | 18.2 | 18.2 | 12.9 |
| Petroleum Systems | 7.2 | 25.4 | 32.7 | 34.3 | 35.1 | 39.5 | 20.7 |
| Petrochemical Production | + | (0.1) | + | + | + | + | + |
| Silicon Carbide Production and Consumption | NC | NC | NC | NC | NC | NC | NC |
| Iron and Steel Production & Metallurgical Coke Production | (1.1) | (0.8) | (0.6) | (0.7) | (0.7) | (0.7) | (0.9) |
| Ferroalloy Production | NC | NC | NC | NC | NC | NC | NC |
| Enteric Fermentation | NC | NC | 0.2 | 0.2 | 0.4 | 0.9 | 0.1 |
| Manure Management | NC | NC | + | 0.1 | + | + | + |
| Rice Cultivation | 4.0 | 4.1 | 0.8 | 3.4 | 2.6 | 3.6 | 2.7 |
| Field Burning of Agricultural Residues | (0.1) | + | + | + | + | + | + |
| Landfills | (6.7) | (11.5) | 20.3 | 23.1 | 27.0 | 29.7 | (6.4) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Wastewater Treatment | + | + | + | + | (0.1) | (0.2) | + |
| Composting | NC | NC | NC | NC | NC | 0.1 | + |
| Incineration of Waste | NC | NC | NC | NC | NC | NC | NC |
| *International Bunker Fuels*[a] | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* |
| **$N_2O$**[b] | **76.3** | **41.7** | **50.3** | **44.6** | **43.7** | **48.2** | **51.4** |
| Stationary Combustion | + | + | + | + | + | + | + |
| Mobile Combustion | + | (3.7) | (0.1) | (0.1) | (0.2) | (0.2) | (1.4) |
| Adipic Acid Production | NC | NC | NC | NC | NC | NC | NC |
| Nitric Acid Production | + | + | + | + | + | NC | + |
| Manure Management | 0.2 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.1 |
| Agricultural Soil Management | 79.3 | 53.5 | 56.4 | 57.3 | 57.1 | 54.9 | 60.1 |
| Field Burning of Agricultural Residues | + | + | + | + | + | + | + |
| Wastewater Treatment | NC | + | (0.2) | (0.1) | (0.1) | (0.1) | (0.1) |
| $N_2O$ from Product Uses | NC | NC | NC | NC | NC | NC | NC |
| Incineration of Waste | NC | NC | NC | NC | NC | NC | NC |
| Composting | NC | NC | NC | NC | NC | 0.1 | + |
| Semiconductor Manufacture | NC | NC | NC | + | + | + | + |
| *International Bunker Fuels*[a] | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* | *NC* |
| **HFCs** | **NC** | **(11.4)** | **(3.1)** | **(3.0)** | **(3.5)** | **(3.7)** | **(6.3)** |
| Substitution of Ozone Depleting Substances | NC | (11.4) | (3.2) | (3.1) | (3.4) | (4.0) | (6.3) |
| HCFC-22 Production | NC | NC | (3.2) | (3.1) | (3.4) | (4.0) | (6.3) |
| Semiconductor Manufacture | NC | + | NC | NC | NC | NC | NC |
| Magnesium Production and Processing | NC | NC | + | + | + | + | + |
| **PFCs** | **NC** | **+** | **NC** | **NC** | **NC** | **NC** | **NC** |
| Aluminum Production | NC | NC | 0.1 | 0.1 | + | + | + |
| Semiconductor Manufacture | NC | + | NC | NC | NC | NC | NC |
| **$SF_6$** | **NC** | **+** | **0.1** | **0.1** | **+** | **+** | **+** |
| Electrical Transmission and Distribution | NC | + | + | + | (0.1) | 0.3 | + |
| Semiconductor Manufacture | NC | + | + | + | (0.1) | 0.3 | + |
| Magnesium Production and Processing | NC | NC | + | + | + | + | + |
| **$NF_3$** | **NC** | **+** | **NC** | **NC** | **NC** | **+** | **+** |
| Semiconductor Manufacture | NC | + | + | + | + | + | + |
| **Net Change in Total Emissions**[b] | **96.1** | **28.6** | **86.6** | **88.8** | **97.9** | **127.0** | |
| **Percent Change** | **1.5%** | **0.4%** | **1.3%** | **1.3%** | **1.5%** | **1.9%** | |

Note: Net change in total emissions presented without LULUCF.
NC - No Change
+ Absolute value does not exceed 0.05 MMT $CO_2$ Eq. or 0.05 percent.
[a] Not included in emissions total.
[b] Totals effect of recalculations is underestimated because the 1990 through 2013 Inventory included emissions frolm LULUCF in totals.
Notes: Totals may not sum due to independent rounding. Parentheses indicate negative values.

## Table 9-2: Revisions to Total Net Flux from Land Use, Land-Use Change, and Forestry (MMT $CO_2$ Eq.)

| Land Use Category | 1990 | 2005 | 2010 | 2011 | 2012 | 2013 | Average Annual Change |
|---|---|---|---|---|---|---|---|
| **Forest Land Remaining Forest Land** | **(82.8)** | **117.9** | **20.9** | **23.9** | **29.6** | **39.1** | **(11.4)** |
| Changes in Forest Carbon Stock[a] | (84.1) | 115.2 | 23.4 | 37.2 | 37.3 | 36.6 | (8.9) |
| Non-$CO_2$ Emissions from Forest Fires | 1.3 | 2.7 | (2.5) | (13.2) | (7.7) | 2.5 | (2.6) |
| $N_2O$ Fluxes from Forest Soils[b] | NC | NC | NC | NC | NC | NC | NC |
| **Land Converted to Forest Land** | **NC*** | **NC*** | **NC*** | **NC*** | **NC*** | **NC*** | **NC*** |
| Changes in Forest Carbon Stock | NC* | NC* | NC* | NC* | NC* | NC* | NC* |
| **Cropland Remaining Cropland** | **30.9** | **13.9** | **27.7** | **13.3** | **14.0** | **12.5** | **16.5** |
| Changes in Agricultural Carbon Stock[c] | 30.9 | 13.9 | 27.7 | 13.3 | 13.8 | 14.2 | 16.5 |
| $CO_2$ Emissions from Liming | NC | NC | NC | + | 0.2 | (2.0) | (0.1) |
| $CO_2$ Emissions from Urea Fertilization | NC | NC | NC | NC | NC | 0.3 | + |
| **Land Converted to Cropland** | **41.2** | **12.3** | **7.5** | **5.4** | **6.0** | **6.0** | **21.8** |
| Changes in Agricultural Carbon Stock[c] | 41.2 | 12.3 | 7.5 | 5.4 | 6.0 | 6.0 | 21.8 |
| **Grassland Remaining Grassland** | **(11.0)** | **(7.5)** | **(19.0)** | **(8.6)** | **(8.0)** | **(8.3)** | **(4.9)** |
| Changes in Agricultural Carbon Stock[c] | (11.0) | (7.5) | (19.0) | (8.6) | (8.0) | (8.3) | (4.9) |
| **Land Converted to Grassland** | **46.5** | **52.1** | **48.2** | **48.7** | **49.1** | **49.1** | **49.0** |
| Changes in Agricultural Carbon Stock[c] | 46.5 | 52.1 | 48.2 | 48.7 | 49.1 | 49.1 | 49.0 |
| **Wetlands Remaining Wetlands** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** | **NC** |
| Peatlands Remaining Peatlands | NC | NC | NC | NC | NC | NC | NC |
| **Settlements Remaining Settlements** | **NC** | **+** | **+** | **+** | **+** | **+** | **+** |
| Changes in Carbon Stocks in Urban Trees | NC | NC | NC | NC | NC | NC | NC |
| $N_2O$ Fluxes from Settlement Soils[d] | NC | + | + | + | + | + | + |
| **Other** | **NC** | **NC** | **+** | **0.5** | **0.5** | **0.9** | **0.1** |
| Landfilled Yard Trimmings and Food Scraps | NC | NC | + | 0.5 | 0.5 | 0.9 | 0.1 |
| **LULUCF Emissions[e]** | **1.3** | **2.7** | **(2.5)** | **(13.2)** | **(7.4)** | **0.8** | |
| **Net Change in LULUCF Total Net Flux[f]** | **22.8** | **185.2** | **87.3** | **96.1** | **98.4** | **98.1** | |
| **LULUCF Sector Total[g]** | **24.1** | **187.9** | **84.9** | **82.9** | **90.9** | **98.9** | |
| **Percent Change** | **3.2%** | **21.2%** | **10.0%** | **9.8%** | **10.8%** | **11.5%** | |

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

[a] Includes the effects of net additions to stocks of carbon stored in forest ecosystem pools and harvested wood products.

[b] Estimates include emissions from N fertilizer additions on both *Forest Land Remaining Forest Land* and *Land Converted to Forest Land*, but not from land-use conversion.

[c] Estimates include C stock changes in all pools.

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

[e] LULUCF emissions include the $CO_2$, $CH_4$, and $N_2O$ emissions reported for Non-$CO_2$ Emissions from Forest Fires, $N_2O$ Fluxes from Forest Soils, $CO_2$ Emissions from Liming, $CO_2$ Emissions from Urea Fertilization, Peatlands Remaining Peatlands, and $N_2O$ Fluxes from Settlement Soils.

[f] LULUCF Total Net Flux includes any C sequestration gains and losses from all land use and land use conversion categories.

[g] The LULUCF Sector Total is the net sum of all emissions (i.e., sources) of greenhouse gases to the atmosphere plus removals of $CO_2$ (i.e., sinks or negative emissions) from the atmosphere.

Notes: Numbers in parentheses indicate an increase in C sequestration. Totals may not sum due to independent rounding.