ANNEX 1 Key Category Analysis

The United States has identified national key categories based on the estimates compiled in this report to inform prioritization of improvements to make the best use of available resources. The *2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) and the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2019) describes a key category as a "… inventory categories which individually, or as a group of categories (for which a common method, emission factor and activity data are applied) are prioritized within the national inventory system because their estimates have a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the level of uncertainty in emissions or removals. Whenever the term key category is used, it includes both source and sink categories." By definition, key categories are sources or sinks that have the greatest contribution to the absolute overall level of national emissions and removals in any of the years covered by the time series. In addition, when an entire time series of emission and removal estimates is prepared, a determination of key categories must also account for the influence of the trends of individual categories. Therefore, a trend assessment is conducted to identify source and sink categories for that may not be large enough to be identified by the level assessment, but whose trend contributes significantly to the overall *Inventory* trend (IPCC 2019). Finally, a qualitative evaluation of key categories should be performed, in order to capture any key categories that were not identified in either of the quantitative analyses, but can be considered key because of the unique country-specific estimation methods.

In sum, this key category analysis includes:

- Approach 1 (including both level and trend assessments);
- Approach 2 (including both level and trend assessments, and incorporating uncertainty analysis); and
- Qualitative approach.

This Annex presents an analysis of key categories, both for sources only and also for sources and sinks (i.e., including Land Use, Land-Use Change and Forestry LULUCF); discusses Approach 1, Approach 2, and qualitative approaches used to identify key categories for the United States; provides level and trend assessment equations; and provides a brief evaluation of IPCC's quantitative methodologies for defining key categories. The Paris Agreement's Enhanced Transparency Framework Reporting Tools generate common reporting tables (CRTs), including Table 7 which also identifies key categories using an Approach 1 analysis based largely on the default disaggregation approach provided in Volume 1, Chapter 4, Table 4.1 of the *2006 IPCC Guidelines* and its *Refinement.* Table 4.1 also includes special considerations for further disaggregation by fuel type for fuel combustion categories. The disaggregation of categories presented in CRT Table 7 and this annex vary but the results of the key category analysis are consistent. Consistent with the UNFCCC and the Paris Agreement reporting guidelines, the United States key category analysis uses the IPCC suggested aggregation level as the basis for the analysis, but in some cases the disaggregation does differ. Differences arise from implementation of special considerations identified in Table 4.1. As stated in section 4.2 in Volume 1, Chapter 4 of the *2006 IPCC Guidelines*, "…countries using Approach 2 will probably choose the same level of aggregation that was used for the uncertainty analysis." In order to retain consistency in the categorization with the uncertainty analysis, the aggregation level for this analysis (i.e. Approach 1, 2 etc.) does reflect some but not all special considerations such as disaggregating for significant subcategories (e.g., for 1.A.1, 3.A, 3.B) and fuel types for the following categories: Fuel Combustion Activities—Water-borne Navigation (1.A.3.d), Fuel Combustion Activities—Other Sectors (1.A.4), Fugitive Emissions from Fuels –Oil (1.B.2.a) and Natural Gas (1.B.2.b), Petrochemical and Carbon Black Production (2.B.8), Direct and Indirect N_2O Emissions (3.D.1 and 3.D.2), land use categories (4.A, 4.B, 4.C, 4.D, 4.E, and 4.F), Solid Waste Disposal (5.A) and Wastewater (5.D). Most other differences stem from additional disaggregation to subcategories consistent with the uncertainty analysis, including within Fuel Combustion Activities—Other Sectors (1.A.4.a Commercial/Institutional and 1.A.4.b Residential), Fossil Fuel Combustion—Non-Specified Stationary (1.A.5.a Incineration of Waste, Non-Energy Use of Fossil Fuels, and U.S. Territories) and Mobile (1.A.5.b Military), Biomass Burning (4.A(V) Forest Fires and 4.C(V) Grass Fires), and Biological Treatment of Solid Waste (5.B.1 Composting and 5.B.2 Anaerobic Digestion at Biogas Facilities). As EPA disaggregates the uncertainty analysis, it will reflect these special considerations in aggregation levels of the key category analysis.

It is important to note that a key category analysis can be sensitive to the definitions of the source and sink categories. The United States has attempted to define source and sink categories by the conventions that would best inform improvement prioritization and still allow comparison with other international key category analyses, so still maintaining

the category definitions that constitute how the emissions estimates were calculated for this report. As such, some of the category names used in the key category analysis may differ from the names used in the main body of the report.

The Approach 1 level assessment uses a 95 percent cumulative emissions threshold to identify key categories, consistent with the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) and the *2019 Refinement to the 2006 IPCC Guidelines (IPCC 2019)*. The Approach 2 level assessment provides additional insight into why certain source and sink categories are considered key, and how to prioritize inventory improvements to reduce overall uncertainties. The key categories identified by the Approach 2 level assessment may differ from those identified by the Approach 1 assessment. The final set of key categories includes all source and sink categories identified as key by either the Approach 1 or the Approach 2 assessment (as noted in Table 1-4 of the Introduction Chapter).

The Approach 1 trend assessment is the percentage change in total inventory estimate from the base year to the current year. Thus, the source or sink category trend assessment will be large if the source or sink category represents a large percentage of emissions and/or has a trend that is quite different from the overall inventory trend. All categories that fall within that cumulative 95 percent are considered key categories. For Approach 2, the trend assessment for each category from Approach 1 is multiplied by its percent relative uncertainty. If the uncertainty reported is asymmetrical, the larger uncertainty is used. All categories that fall within that cumulative 90 percent are considered key categories. When source and sink categories are sorted in decreasing order of this calculation, those that fall at the top of the list and cumulatively account for 90 percent of emissions are considered key categories. The final set of key categories includes all source and sink categories identified as key by either the Approach 1 or the Approach 2 assessment, keeping in mind that the two assessments are not mutually exclusive.

Finally, in addition to conducting Approach 1 and 2 level and trend assessments, a qualitative assessment of categories, as described in the *2006 IPCC Guidelines* and the *2019 Refinement to the 2006 IPCC Guidelines,* was conducted to capture any key categories that were not identified by either quantitative method. For this *Inventory*, no additional categories were identified using criteria recommend by IPCC, but EPA continues to review its qualitative assessment on an annual basis. Documentation of the analyses are available as described below.

- **Level Assessment:** Table KCA-1 through Table KCA-4 contain the 1990 and 2022 level assessments for both with and without LULUCF sources and sinks, and contain further detail on where each source falls within the analysis. In the tables, Approach 1 key categories are shaded dark gray. Additional key categories identified by the Approach 2 assessment are shaded light gray. Tables KCA-1 through KCA-4 are available online under Annex 1 at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022
- **Trend Assessment:** Table KCA-5 through Table KCA-6 contain the trend assessments with and without LULUCF sources and sinks, and contain further detail on where each source falls within the analysis. In the tables, similar to the Approach 1 and 2 level assessment tables, the Approach 1 trend assessment key categories are shaded dark gray. Additional key categories identified by the Approach 2 assessment are shaded light gray. Tables KCA-5 through KCA-6 are available online under Annex 1 at: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022.

Table A-1 indicates the key category rank across approach 1 analyses, the methods applied, and any relevant methodological notes for categories identified as key (i.e., as summarized in Chapter 1.5 of this *Inventory*). Key category ranks for additional analyses included in Table KCA-7 through Table KCA-8 available online at link provided in the previous paragraph.

Table A-1: Summary of 2022 Key Categories with Rank and Methods Applied for the United States by Sector

CRT Code and Source/Sink Category	GHG	2022 Level A1 Ranking With LULUCF	2022 Trend A1 Ranking with LULUCF	Methods Applied	Notes
Energy					
1.A.3.b Transportation: Road	CO_2	1	3	T2, M	
1.A.1 Stationary Combustion - Coal - Electricity Generation	CO_2	2	1	T2	
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	CO_2	4	2	T2	
1.A.2 Stationary Combustion - Natural Gas - Industrial	CO_2	5	7	T2	
1.A.4.b Stationary Combustion - Natural Gas - Residential	CO_2	6	17	T2	
1.A.2 Stationary Combustion - Oil - Industrial	CO_2	8	12	T2	
1.A.4.a Stationary Combustion - Natural Gas - Commercial	CO_2	9	14	T2	
1.A.3.a Transportation: Aviation	CO_2	12	22	T2, T3	
1.A.5 Non-Energy Use of Fuels	CO_2	15	50	T2	
1.A.3.e Transportation: Other	CO_2	18	18	T2	
1.A.4.a Stationary Combustion - Oil - Commercial	CO_2	20	37	T2	
1.A.4.b Stationary Combustion - Oil - Residential	CO_2	21	16	T2	
1.A.2 Stationary Combustion - Coal - Industrial	CO_2	24	6	T2	
1.A.3.d Transportation: Domestic Navigation	CO_2	26	77	T2, M	
1.B.2 Natural Gas Systems	CO_2	30	48	CS	
1.A.3.c Transportation: Railways	CO_2	32	58	T2	
1.B.2 Petroleum Systems	CO_2	38	27	CS	
1.A.1 Stationary Combustion - Oil - Electricity Generation	CO_2	40	9	T2	
1.A.5 Stationary Combustion - Oil - U.S. Territories	CO_2	45	64	T2	
1.A.5.b Transportation: Military	CO_2	53	38	T2	
1.A.4.a Stationary Combustion - Coal - Commercial	CO_2	57	32	T2	
1.A.4.b Stationary Combustion - Coal - Residential	CO_2	59	57	T2	
1.B.2 Natural Gas Systems	CH_4	11	15	CS	
1.B.1 Fugitive Emissions from Coal Mining	CH_4	23	10	T2, T3	
1.B.2 Petroleum Systems	CH_4	28	35	CS	
1.B.2 Abandoned Oil and Natural Gas Wells	CH_4	50	88	CS	

CRT Code and Source/Sink Category	GHG	2022 Level A1 Ranking With LULUCF	2022 Trend A1 Ranking with LULUCF	Methods Applied	Notes
1.A.4.b Stationary Combustion - Residential	CH_4	54	78	T2	
1.A.1 Stationary Combustion - Coal - Electricity Generation	N_2O	43	99	T2	
1.A.3.b Transportation: Road	N_2O	49	21	T3, M	
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	N_2O	55	56	T2	
Industrial Processes and Product Use					
2.A.1 Cement Production	CO_2	25	40	T2	
2.C.1 Iron and Steel Production & Metallurgical Coke Production	CO_2	27	11	T1, T2, CS	T1 used for sinter production, pellet production and DRI Production due to insufficient data. Together, emissions from these subcategories contribute 8 percent of total 2.C.1 emissions in 2022. More information is available under the Methodology and Time-Series Consistency section of Chapter 4.18.
2.B.8 Petrochemical Production	CO_2	34	39	T1, CS	T1 used for estimating CO_2 and CH_4 from acrylonitrile due to data CBI. Data reported under EPA's GHGRP is considered CBI and cannot be published for this subcategory. Acrylonitrile emissions are 3 percent of total petrochemical emissions in 2022. More information is available under the Methodology and Time-Series Consistency section of Chapter 4.13.
2.B.3 Adipic Acid Production	N_2O	56	29	T3	
2.F.1 Substitutes for Ozone Depleting Substances: Refrigeration and Air Conditioning	HFCs, PFCs	13	5	T2, T3	
2.F.4 Substitutes for Ozone Depleting Substances: Aerosols	HFCs, PFCs	44	26	T2, T3	
2.F.2 Substitutes for Ozone Depleting Substances: Foam Blowing Agents	HFCs, PFCs	48	28	T2, T3	
2.B.9 Fluorochemical Production	PFCs, HFCs SF_6, NF_3	51	13	T1, T3	

CRT Code and Source/Sink Category	GHG	2022 Level A1 Ranking With LULUCF	2022 Trend A1 Ranking with LULUCF	Methods Applied	Notes
2.G Electrical Equipment	PFCs, SF_6	52	24	M, T2, T3	
2.C.3 Aluminum Production	PFCs	58	25	M, T1, T2,	Tier 1 is used for estimating emissions from low voltage anode effects (LVAE) due to data availability. These emissions were estimated consistent using methods from the *2019 Refinement* to reflect the latest science and improve completeness. LVAE emissions are 2% of total emissions from aluminum production in 2022. More information is available under the Methodology and Time-Series Consistency section of Chapter 4.20.
Agriculture					
3.A.1 Enteric Fermentation: Cattle	CH_4	10	34	M, T2	
3.B.1 Manure Management: Cattle	CH_4	29	23	M, T1, T2	Specific parameters where a Tier 2 method is applicable due to available data, a Tier 2 method is used, some of which are modeled (M) within the Cattle Enteric Fermentation Model (CEFM). Other parameters follow the Tier 1 approach or default emission factors, largely due to data availability. More information is available under the Methodology and Time-Series Consistency discussion in section 5.2.

CRT Code and Source/Sink Category	GHG	2022 Level A1 Ranking With LULUCF	2022 Trend A1 Ranking with LULUCF	Methods Applied	Notes
3.B.4 Manure Management: Other Livestock	CH_4	36	44	M, T1, T2	Specific parameters where a Tier 2 method is applicable due to available data, a Tier 2 method is used (e.g., to calculate MCF for liquid manure management systems), some of which are modeled (M) within the Cattle Enteric Fermentation Model (CEFM), specifically for American Bison. Other parameters follow the Tier 1 approach or default emission factors, (e.g., MCF for dry manure management systems) largely due to data availability. More information is available under the Methodology and Time-Series Consistency discussion in Section 5.2.
3.C Rice Cultivation	CH_4	42	117	T1, T3	Tier 1 method is used for rice when grown in rotation with crops that are not simulated by DayCent, such as vegetable crops, and areas converted between agriculture (i.e., cropland and grassland) and other land uses. Tier 1 method is also used to estimate CH_4 emissions from organic soils (i.e., Histosols) and from areas with very gravelly, cobbly, or shaley soils (greater than 35 percent by volume). DayCent has not been tested for modeling these conditions. Tier 3 is used for other conditions. More information is available under the Methodology and Time-Series section of Section 5.3.
3.D.1 Direct Emissions from Agricultural Soil Management	N_2O	7	51	T1, T3, CS	Tier 1 is applied as follows: 1) Mineral cropland soils where DayCent has not been parametrized. 2) Non-manure commercial organic amendments added to cropland soils. 3) Drained organic soils on croplands and grasslands. 4) Biosolids (sewage sludge) additions to grasslands. 5) PRP manure on federal grasslands.

CRT Code and Source/Sink Category	GHG	2022 Level A1 Ranking With LULUCF	2022 Trend A1 Ranking with LULUCF	Methods Applied	Notes
3.D.2 Indirect Emissions from Applied Nitrogen	N_2O	35	76	T1, T3	Tier 1 is applied as follows: 1) Nitrogen volatilization for croplands/grasslands not simulated by DayCent. 2) Tier 1 IPCC EF is applied to nitrogen volatilization data generated by DayCent and the volatilization data for croplands/grassland not simulated by DayCent. 3) Nitrogen leaching/runoff for croplands/grasslands not simulated by DayCent. 4) Tier 1 IPCC EF is applied to N leaching/runoff data generated by DayCent and the leaching/runoff data for croplands/grassland not simulated by DayCent.
Waste					
5.A Commercial Landfills	CH_4	16	8	T2, T3	
5.A Industrial Landfills	CH_4	41	42	M	
5.D Domestic Wastewater Treatment	CH_4	46	60	T2	
5.D Domestic Wastewater Treatment	N_2O	39	41	T2	
Land Use, Land-Use Change, and Forestry					
4.E.2 Net Emissions from Land Converted to Settlements	CO_2	19	31	T2	
4.B.2 Net Emissions from Land Converted to Cropland	CO_2	31	33	T2, T3, CS	
4.C.2 Net Emissions from Land Converted to Grassland	CO_2	37	36	T2, T3, CS	
4.C.1 Net Emissions from Grassland Remaining Grassland	CO_2	47	30	T2, T3, CS	
4.B.1 Net Removals from Cropland Remaining Cropland	CO_2	33	19	T2, T3, CS	
4.A.2 Net Removals from Land Converted to Forest Land	CO_2	17	118	T2, T3, CS	
4.E.1 Net Removals from Settlements Remaining Settlements	CO_2	14	20	T2, T3, CS	
4.A.1 Net Removals from Forest Land Remaining Forest Land	CO_2	3	4	T2, T3, CS	
4.D.1 Flooded Land Remaining Flooded Land	CH_4	22	70	T1	See the Planned Improvements section in Section 6.8. Work has been underway to develop country-specific emission factors.

Table A-2 provides a complete listing of categories by CRT code/sector, along with notations on the criteria used in identifying key categories, excluding the LULUCF sources and sinks. Similarly, Table A-3 provides a complete listing of source and sink categories by CRT code/sector, along with notations on the criteria used in identifying key categories, including LULUCF sources and sinks. The notations refer specifically to the year(s) in the *Inventory* time series (i.e., 1990 to 2022) in which each source or sink category reached the threshold for being a key category based on either an Approach 1 or Approach 2 level assessment.

Table A-2: U.S. Greenhouse Gas Inventory Source Categories without LULUCF

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)
Energy						
1.A.3.b Transportation: Road	CO_2	1,157.4	1,438.1	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.1 Stationary Combustion - Coal - Electricity Generation	CO_2	1,546.5	851.5	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	CO_2	175.4	659.3	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.2 Stationary Combustion - Natural Gas - Industrial	CO_2	407.4	510.4	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.4.b Stationary Combustion - Natural Gas - Residential	CO_2	237.8	272.0	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.2 Stationary Combustion - Oil - Industrial	CO_2	311.2	247.6	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.4.a Stationary Combustion - Natural Gas - Commercial	CO_2	142.0	192.3	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.3.a Transportation: Aviation	CO_2	187.2	165.6	•	L_1 T_1 L_2	1990, 2022
1.A.5 Non-Energy Use of Fuels	CO_2	99.1	102.8	•	L_1 L_2 T_2	1990, 2022
1.A.3.e Transportation: Other	CO_2	36.0	69.3	•	L_1 T_1 T_2	1990_1, 2022_1
1.A.4.a Stationary Combustion - Oil - Commercial	CO_2	74.3	65.1	•	L_1 T_1	1990_1, 2022_1
1.A.4.b Stationary Combustion - Oil - Residential	CO_2	97.8	62.1	•	L_1 T_1	1990_1, 2022_1
1.A.2 Stationary Combustion - Coal - Industrial	CO_2	157.8	43.0	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.3.d Transportation: Domestic Navigation	CO_2	39.3	40.9	•	L_1	1990_1, 2022_1
1.B.2 Natural Gas Systems	CO_2	32.4	36.5	•	L_1	1990_1, 2022_1
1.A.3.c Transportation: Railways	CO_2	35.5	32.5	•	L_1	1990_1, 2022_1
1.B.2 Petroleum Systems	CO_2	9.6	22.0	•	L_1 T_1 T_2	2022_1
1.A.1 Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	20.5	•	L_1 T_1 L_2 T_2	1990, 2022_1
1.A.5 Stationary Combustion - Oil - U.S. Territories	CO_2	19.5	17.0	•	L_1	1990_1
5.C.1 Incineration of Waste	CO_2	12.9	12.4			
1.A.5.b Transportation: Military	CO_2	13.6	4.8	•	T_1	
1.A.5 Stationary Combustion - Coal - U.S. Territories	CO_2	0.5	2.9			
1.A.5 Stationary Combustion - Natural Gas - U.S. Territories	CO_2	NO	2.7			
1.B.1 Coal Mining	CO_2	4.6	2.5			
1.A.4.a Stationary Combustion - Coal - Commercial	CO_2	12.0	1.4	•	T_1	

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)
1.A.1 Stationary Combustion - Geothermal Energy	CO_2	0.5	0.4			
1.B.2 Abandoned Oil and Natural Gas Wells	CO_2	+	+			
1.A.4.b Stationary Combustion - Coal - Residential[b]	CO_2	3.0	NO	•	T_2	
1.B.2 Natural Gas Systems	CH_4	218.8	173.1	•	L_1 T_1 L_2 T_2	1990, 2022
1.B.1 Fugitive Emissions from Coal Mining	CH_4	108.1	43.6	•	L_1 T_1 L_2 T_2	1990, 2022
1.B.2 Petroleum Systems	CH_4	49.4	39.6	•	L_1 T_1 L_2 T_2	1990, 2022
1.B.2 Abandoned Oil and Natural Gas Wells	CH_4	7.8	8.5	•	L_2	1990_2, 2022_2
1.B.1 Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	8.1	6.3			
1.A.4.b Stationary Combustion - Residential	CH_4	5.9	4.3	•	L_2 T_2	1990_2, 2022_2
1.A.2 Stationary Combustion - Industrial	CH_4	2.1	1.6			
1.A.4.a Stationary Combustion - Commercial	CH_4	1.2	1.4			
1.A.3.e Transportation: Other	CH_4	0.8	1.1			
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	CH_4	0.1	1.0			
1.A.3.b Transportation: Road	CH_4	5.8	0.9			
1.A.3.d Transportation: Domestic Navigation	CH_4	0.4	0.5			
1.A.1 Stationary Combustion - Coal - Electricity Generation	CH_4	0.4	0.2			
1.A.3.c Transportation: Railways	CH_4	0.1	0.1			
1.A.3.a Transportation: Aviation	CH_4	0.1	+			
1.A.5 Stationary Combustion - U.S. Territories	CH_4	+	+			
5.B.2 Anaerobic Digestion at Biogas Facilities	CH_4	+	+			
1.A.1 Stationary Combustion - Wood - Electricity Generation	CH_4	+	+			
1.A.1 Stationary Combustion - Oil - Electricity Generation	CH_4	+	+			
1.A.5.b Transportation: Military	CH_4	+	+			
5.C.1 Incineration of Waste[c]	CH_4	+	+			
1.A.1 Stationary Combustion - Coal - Electricity Generation	N_2O	17.9	18.2	•	L_2	1990_2, 2022_2
1.A.3.b Transportation: Road	N_2O	32.3	8.9	•	L_1 T_1	1990_1
1.A.3.e Transportation: Other	N_2O	4.2	6.0			
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	N_2O	0.3	3.4	•	T_2	

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)
1.A.2 Stationary Combustion - Industrial	N_2O	2.8	2.0			
1.A.3.a Transportation: Aviation	N_2O	1.5	1.4			
1.A.4.b Stationary Combustion - Residential	N_2O	0.9	0.7			
5.C.1 Incineration of Waste	N_2O	0.4	0.3			
1.A.4.a Stationary Combustion - Commercial	N_2O	0.3	0.3			
1.A.3.d Transportation: Domestic Navigation	N_2O	0.2	0.3			
1.A.3.c Transportation: Railways	N_2O	0.2	0.2			
1.B.2 Natural Gas Systems	N_2O	+	0.2			
1.A.5 Stationary Combustion - U.S. Territories	N_2O	+	0.1			
1.B.2 Petroleum Systems	N_2O	+	+			
1.A.1 Stationary Combustion - Wood - Electricity Generation	N_2O	+	+			
1.A.1 Stationary Combustion - Oil - Electricity Generation	N_2O	0.1	+			
1.A.5.b Transportation: Military	N_2O	+	+			
Industrial Processes and Product Use						
2.A.1 Cement Production	CO_2	33.5	41.9	•	L_1	1990_1, 2022_1
2.C.1 Iron and Steel Production & Metallurgical Coke Production	CO_2	104.7	40.7	•	L_1 T_1 L_2 T_2	1990, 2022
2.B.8 Petrochemical Production	CO_2	20.1	28.8	•	L_1 T_1	1990_1, 2022_1
2.B.1 Ammonia Production	CO_2	14.4	12.6			
2.A.2 Lime Production	CO_2	11.7	12.2			
2.A.4 Other Process Uses of Carbonates	CO_2	7.1	10.4			
2.B.10 Urea Consumption for Non-Ag Purposes	CO_2	3.8	7.1			
2.B.10 Carbon Dioxide Consumption	CO_2	1.5	5.0			
2.A.3 Glass Production	CO_2	2.3	2.0			
2.B.7 Soda Ash Production	CO_2	1.4	1.7			
2.B.6 Titanium Dioxide Production	CO_2	1.2	1.5			
2.C.3 Aluminum Production	CO_2	6.8	1.4			
2.C.2 Ferroalloy Production	CO_2	2.2	1.3			
2.C.6 Zinc Production	CO_2	0.6	0.9			
2.B.10 Phosphoric Acid Production	CO_2	1.5	0.8			
2.C.5 Lead Production	CO_2	0.5	0.4			
2.B.5 Silicon Carbide Production and Consumption	CO_2	0.2	0.2			
2.C.4 Magnesium Production and Processing	CO_2	0.1	+			
2.B.5 Silicon Carbide Production and Consumption	CH_4	+	+			
2.C.2 Ferroalloy Production	CH_4	+	+			
2.C.1 Iron and Steel Production & Metallurgical Coke Production	CH_4	+	+			

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)
2.B.8 Petrochemical Production	CH_4	+	+			
2.B.2 Nitric Acid Production	N_2O	10.8	8.6			
2.G Other Product Manufacture and Use	N_2O	3.8	3.8			
2.B.3 Adipic Acid Production	N_2O	13.5	2.1	•	T_1	
2.B.4 Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.5	1.3			
2.E Electronics Industry	N_2O	+	0.3			
2.F.1 Emissions from Substitutes for Ozone Depleting Substances: Refrigeration and Air conditioning	HFCs, PFCs	+	144.6	•	L_1 T_1 L_2 T_2	2022
2.F.4 Emissions from Substitutes for Ozone Depleting Substances: Aerosols	HFCs, PFCs	0.2	17.0	•	T_1 L_2 T_2	2022_2
2.F.2 Emissions from Substitutes for Ozone Depleting Substances: Foam Blowing Agents	HFCs, PFCs	+	11.7	•	T_1	
2.F.3 Emissions from Substitutes for Ozone Depleting Substances: Fire Protection	HFCs, PFCs	NO	2.6			
2.F.5 Emissions from Substitutes for Ozone Depleting Substances: Solvents	HFCs, PFCs	NO	2.1			
2.B.9 Fluorochemical Production	PFCs, HFCs, SF_6, NF_3	70.9	7.8	•	L_1 T_1 L_2 T_2	1990
2.G Electrical Equipment	PFCs, SF_6	24.7	5.1	•	L_1 T_1 T_2	1990_1
2.E Electronics Industry	PFCs, HFCs, SF_6, NF_3	3.3	4.4			
2.C.4 Magnesium Production and Processing	SF_6	5.6	1.1			
2.G Other Product Manufacture and Use	PFCs, SF_6	1.4	0.8			
2.C.3 Aluminum Production	PFCs	19.3	0.8	•	L_1 T_1	1990_1
2.C.4 Magnesium Production and Processing	HFCs	NO	+			
Agriculture						
3.H Urea Fertilization	CO_2	2.4	5.3			
3.G Liming	CO_2	4.7	3.3			
3.A.1 Enteric Fermentation: Cattle	CH_4	176.1	185.9	•	L_1 T_1 L_2 T_2	1990, 2022
3.B.1 Manure Management: Cattle	CH_4	17.8	37.7	•	L_1 T_1 L_2 T_2	2022
3.B.4 Manure Management: Other Livestock	CH_4	21.4	27.0	•	L_1 L_2	1990_1, 2022
3.C Rice Cultivation	CH_4	18.9	18.9	•	L_1 L_2	1990, 2022
3.A.4 Enteric Fermentation: Other Livestock	CH_4	7.0	6.7			
3.F Field Burning of Agricultural Residues	CH_4	0.5	0.6			
3.D.1 Direct Agricultural Soil Management	N_2O	258.8	262.5	•	L_1 L_2	1990, 2022

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)
3.D.2 Indirect Applied Nitrogen	N_2O	29.9	28.3	•	L_1 L_2 T_2	1990, 2022
3.B.1 Manure Management: Cattle	N_2O	10.7	12.6			
3.B.4 Manure Management: Other Livestock	N_2O	2.6	4.4			
3.F Field Burning of Agricultural Residues	N_2O	0.2	0.2			
Waste						
5.A Commercial Landfills	CH_4	185.5	100.9	•	L_1 T_1 L_2 T_2	1990, 2022
5.A Industrial Landfills	CH_4	12.2	18.9	•	L_1 L_2 T_2	2022
5.D Domestic Wastewater Treatment	CH_4	16.5	13.6	•	L_2	1990_2
5.D Industrial Wastewater Treatment	CH_4	6.2	7.2			
5.B Composting	CH_4	0.4	2.6			
5.D Domestic Wastewater Treatment	N_2O	14.4	21.4	•	L_1 L_2 T_2	1990_2, 2022
5.B Composting	N_2O	0.3	1.8			
5.D Industrial Wastewater Treatment	N_2O	0.4	0.5			
5.A Commercial Landfills	CH_4	185.5	100.9	•	L_1 T_1 L_2 T_2	1990, 2022

+ Absolute value does not exceed 0.05 MMT CO_2 Eq.

NO (Not Occurring)

[a] If the source is a key category for both L_1 and L_2 (as designated in the ID criteria column), it is a key category for both assessments in the years provided unless noted by a subscript, in which case it is a key category for that assessment in that year only (e.g., 1990_2 designates a category is key for the Approach 2 assessment only in 1990).

[b] Since 2008, emissions from this source category have been estimated to be not occurring, therefore uncertainty has not been estimated for this source. Uncertainty will be estimated in the 1990-2023 Inventory.

[c] This source was introduced in the 1990-2009 Inventory and since 1990, emissions have been estimated to be close to zero, therefore uncertainty has not been estimated for this source. Uncertainty will be estimated in the 1990-2023 Inventory.

Note: LULUCF sources and sinks are not included in the analysis presented in this table. See Table A-3 for the results of the analysis with LULUCF.

Table A-3: U.S. Greenhouse Gas Inventory Source Categories with LULUCF

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
Energy						
1.A.3.b Transportation: Road	CO_2	1,157.4	1,438.1	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.1 Stationary Combustion - Coal - Electricity Generation	CO_2	1,546.5	851.5	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	CO_2	175.4	659.3	•	L_1 T_1 L_2 T_2	1990_1, 2022
1.A.2 Stationary Combustion - Natural Gas - Industrial	CO_2	407.4	510.4	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.4.b Stationary Combustion - Natural Gas - Residential	CO_2	237.8	272.0	•	L_1 T_1 L_2	1990, 2022

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.2 Stationary Combustion - Oil - Industrial	CO_2	311.2	247.6	•	L_1 T_1 L_2 T_2	1990, 2022
1.A.4.a Stationary Combustion - Natural Gas - Commercial	CO_2	142.0	192.3	•	L_1 T_1 L_2 T_2	1990_1, 2022
1.A.3.a Transportation: Aviation	CO_2	187.2	165.6	•	L_1 T_1 L_2	1990, 2022
1.A.5 Non-Energy Use of Fuels	CO_2	99.1	102.8	•	L_1 L_2	1990, 2022
1.A.3.e Transportation: Other	CO_2	36.0	69.3	•	L_1 T_1	1990_1, 2022_1
1.A.4.a Stationary Combustion - Oil - Commercial	CO_2	74.3	65.1	•	L_1 T_1	1990_1, 2022_1
1.A.4.b Stationary Combustion - Oil - Residential	CO_2	97.8	62.1	•	L_1 T_1	1990_1, 2022_1
1.A.2 Stationary Combustion - Coal - Industrial	CO_2	157.8	43.0	•	L_1 T_1 L_2 T_2	1990, 2022_1
1.A.3.d Transportation: Domestic Navigation	CO_2	39.3	40.9	•	L_1	1990_1, 2022_1
1.B.2 Natural Gas Systems	CO_2	32.4	36.5	•	L_1	1990_1, 2022_1
1.A.3.c Transportation: Railways	CO_2	35.5	32.5	•	L_1	1990_1, 2022_1
1.B.2 Petroleum Systems	CO_2	9.6	22.0	•	L_1 T_1 T_2	2022_1
1.A.1 Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	20.5	•	L_1 T_1 T_2	1990_1, 2022_1
1.A.5 Stationary Combustion - Oil - U.S. Territories	CO_2	19.5	17.0	•	L_1	1990_1
5.C.1 Incineration of Waste	CO_2	12.9	12.4			
1.A.5.b Transportation: Military	CO_2	13.6	4.8	•	T_1	
1.A.5 Stationary Combustion - Coal - U.S. Territories	CO_2	0.5	2.9			
1.A.5 Stationary Combustion - Natural Gas - U.S. Territories	CO_2	0.0	2.7			
1.B.1 Coal Mining	CO_2	4.6	2.5			
1.A.4.a Stationary Combustion - Coal - Commercial	CO_2	12.0	1.4	•	T_1	
1.A.1 Stationary Combustion - Geothermal Energy	CO_2	0.5	0.4			
1.B.2 Abandoned Oil and Natural Gas Wells	CO_2	+	+			
1.A.4.b Stationary Combustion - Coal - Residential	CO_2	3.0	0.0			
1.B.2 Natural Gas Systems	CH_4	218.8	173.1	•	L_1 T_1 L_2 T_2	1990, 2022
1.B.1 Fugitive Emissions from Coal Mining	CH_4	108.1	43.6	•	L_1 T_1 L_2 T_2	1990, 2022
1.B.2 Petroleum Systems	CH_4	49.4	39.6	•	L_1 T_1 L_2	1990, 2022
1.B.2 Abandoned Oil and Natural Gas Wells	CH_4	7.8	8.5	•	L_2	1990_2, 2022_2
1.B.1 Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	8.1	6.3			
1.A.4.b Stationary Combustion - Residential	CH_4	5.9	4.3	•	L_2 T_2	1990_2, 2022_2
1.A.2 Stationary Combustion - Industrial	CH_4	2.1	1.6			

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
1.A.4.a Stationary Combustion - Commercial	CH_4	1.2	1.4			
1.A.3.e Transportation: Other	CH_4	0.8	1.1			
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	CH_4	0.1	1.0			
1.A.3.b Transportation: Road	CH_4	5.8	0.9			
1.A.3.d Transportation: Domestic Navigation	CH_4	0.4	0.5			
1.A.1 Stationary Combustion - Coal - Electricity Generation	CH_4	0.4	0.2			
1.A.3.c Transportation: Railways	CH_4	0.1	0.1			
1.A.3.a Transportation: Aviation	CH_4	0.1	+			
1.A.5 Stationary Combustion - U.S. Territories	CH_4	+	+			
5.B.2 Anaerobic Digestion at Biogas Facilities	CH_4	+	+			
1.A.1 Stationary Combustion - Wood - Electricity Generation	CH_4	+	+			
1.A.1 Stationary Combustion - Oil - Electricity Generation	CH_4	+	+			
1.A.5.b Transportation: Military	CH_4	+	+			
5.C.1 Incineration of Waste	CH_4	+	+			
1.A.1 Stationary Combustion - Coal - Electricity Generation	N_2O	17.9	18.2	•	L_2	2022_2
1.A.3.b Transportation: Road	N_2O	32.3	8.9	•	L_1 T_1	1990_1
1.A.3.e Transportation: Other	N_2O	4.2	6.0			
1.A.1 Stationary Combustion - Natural Gas - Electricity Generation	N_2O	0.3	3.4			
1.A.2 Stationary Combustion - Industrial	N_2O	2.8	2.0			
1.A.3.a Transportation: Aviation	N_2O	1.5	1.4			
1.A.4.b Stationary Combustion - Residential	N_2O	0.9	0.7			
5.C.1 Incineration of Waste	N_2O	0.4	0.3			
1.A.4.a Stationary Combustion - Commercial	N_2O	0.3	0.3			
1.A.3.d Transportation: Domestic Navigation	N_2O	0.2	0.3			
1.A.3.c Transportation: Railways	N_2O	0.2	0.2			
1.B.2 Natural Gas Systems	N_2O	+	0.2			
1.A.5 Stationary Combustion - U.S. Territories	N_2O	+	0.1			
1.B.2 Petroleum Systems	N_2O	+	+			
1.A.1 Stationary Combustion - Wood - Electricity Generation	N_2O	+	+			
1.A.1 Stationary Combustion - Oil - Electricity Generation	N_2O	0.1	+			
1.A.5.b Transportation: Military	N_2O	+	+			
Industrial Processes and Product Use						

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
2.A.1 Cement Production	CO_2	33.5	41.9	•	L_1 T_1	1990_1, 2022_1
2.C.1 Iron and Steel Production & Metallurgical Coke Production	CO_2	104.7	40.7	•	L_1 T_1 L_2 T_2	1990, 2022_1
2.B.8 Petrochemical Production	CO_2	20.1	28.8	•	L_1 T_1	1990_1, 2022_1
2.B.1 Ammonia Production	CO_2	14.4	12.6			
2.A.2 Lime Production	CO_2	11.7	12.2			
2.A.4 Other Process Uses of Carbonates	CO_2	7.1	10.4			
2.B.10 Urea Consumption for Non-Ag Purposes	CO_2	3.8	7.1			
2.B.10 Carbon Dioxide Consumption	CO_2	1.5	5.0			
2.A.3 Glass Production	CO_2	2.3	2.0			
2.B.7 Soda Ash Production	CO_2	1.4	1.7			
2.B.6 Titanium Dioxide Production	CO_2	1.2	1.5			
2.C.3 Aluminum Production	CO_2	6.8	1.4			
2.C.2 Ferroalloy Production	CO_2	2.2	1.3			
2.C.6 Zinc Production	CO_2	0.6	0.9			
2.B.10 Phosphoric Acid Production	CO_2	1.5	0.8			
2.C.5 Lead Production	CO_2	0.5	0.4			
2.B.5 Silicon Carbide Production and Consumption	CO_2	0.2	0.2			
2.C.4 Magnesium Production and Processing	CO_2	0.1	+			
2.B.5 Silicon Carbide Production and Consumption	CH_4	+	+			
2.C.2 Ferroalloy Production	CH_4	+	+			
2.C.1 Iron and Steel Production & Metallurgical Coke Production	CH_4	+	+			
2.B.8 Petrochemical Production	CH_4	+	+			
2.B.2 Nitric Acid Production	N_2O	10.8	8.6			
2.G Other Product Manufacture and Use	N_2O	3.8	3.8			
2.B.3 Adipic Acid Production	N_2O	13.5	2.1	•	T_1	
2.B.4 Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.5	1.3			
2.E Electronics Industry	N_2O	+	0.3			
2.F.1 Emissions from Substitutes for Ozone Depleting Substances: Refrigeration and Air conditioning	HFCs, PFCs	+	144.6	•	L_1 T_1 L_2 T_2	2022
2.F.4 Emissions from Substitutes for Ozone Depleting Substances: Aerosols	HFCs, PFCs	0.2	17.0	•	T_1 L_2 T_2	2022_2
2.F.2 Emissions from Substitutes for Ozone Depleting Substances: Foam Blowing Agents	HFCs, PFCs	+	11.7	•	T_1	
2.F.3 Emissions from Substitutes for Ozone Depleting Substances: Fire Protection	HFCs, PFCs	0.0	2.6			
2.F.5 Emissions from Substitutes for Ozone Depleting Substances: Solvents	HFCs, PFCs	0.0	2.1			

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
2.B.9 Fluorochemical Production	PFCs, HFCs, SF_6, NF_3	70.9	7.8	•	L_1 T_1 L_2 T_2	1990
2.G Electrical Equipment	PFCs, SF_6	24.7	5.1	•	L_1 T_1 T_2	1990_1
2.E Electronics Industry	PFCs, HFCs, SF_6, NF_3	3.3	4.4			
2.C.4 Magnesium Production and Processing	SF_6	5.6	1.1			
2.G Other Product Manufacture and Use	PFCs, SF_6	1.4	0.8			
2.C.3 Aluminum Production	PFCs	19.3	0.8	•	L_1 T_1	1990_1
2.C.4 Magnesium Production and Processing	HFCs	0.0	+			
Agriculture						
3.H Urea Fertilization	CO_2	2.4	5.3			
3.G Liming	CO_2	4.7	3.3			
3.A.1 Enteric Fermentation: Cattle	CH_4	176.1	185.9	•	L_1 T_1 L_2 T_2	1990, 2022
3.B.1 Manure Management: Cattle	CH_4	17.8	37.7	•	L_1 T_1 T_2	2022_1
3.B.4 Manure Management: Other Livestock	CH_4	21.4	27.0	•	L_1	1990_1, 2022_1
3.C Rice Cultivation	CH_4	18.9	18.9	•	L_1 L_2	1990_2, 2022
3.A.4 Enteric Fermentation: Other Livestock	CH_4	7.0	6.7			
3.F Field Burning of Agricultural Residues	CH_4	0.5	0.6			
3.D.1 Direct Agricultural Soil Management	N_2O	258.8	262.5	•	L_1 L_2	1990, 2022
3.D.2 Indirect Applied Nitrogen	N_2O	29.9	28.3	•	L_1 L_2	1990, 2022
3.B.1 Manure Management: Cattle	N_2O	10.7	12.6			
3.B.4 Manure Management: Other Livestock	N_2O	2.6	4.4			
3.F Field Burning of Agricultural Residues	N_2O	0.2	0.2			
Waste						
5.A Commercial Landfills	CH_4	185.5	100.9	•	L_1 T_1 L_2 T_2	1990, 2022
5.A Industrial Landfills	CH_4	12.2	18.9	•	L_1	2022_1
5.D Domestic Wastewater Treatment	CH_4	16.5	13.6			
5.D Industrial Wastewater Treatment	CH_4	6.2	7.2			
5.B Composting	CH_4	0.4	2.6			
5.D Domestic Wastewater Treatment	N_2O	14.4	21.4	•	L_1 L_2 T_2	1990_2, 2022
5.B Composting	N_2O	0.3	1.8			
5.D Industrial Wastewater Treatment	N_2O	0.4	0.5			
5.A Commercial Landfills	CH_4	185.5	100.9	•	L_1 T_1 L_2 T_2	1990, 2022
Land Use, Land Use Change, and Forestry						
4.E.2 Net Land Converted to Settlements	CO_2	57.2	68.2	•	L_1 T_1 L_2 T_2	1990, 2022

CRT Code and Source/Sink Category	Greenhouse Gas	1990 Emissions (MMT CO_2 Eq.)	2022 Emissions (MMT CO_2 Eq.)	Key Category	ID Criteria[a]	Level in which year(s)[b]
4.B.2 Net Land Converted to Cropland	CO_2	45.4	35.1	•	L_1 T_1 L_2 T_2	1990, 2022
4.C.2 Net Land Converted to Grassland	CO_2	35.3	25.6	•	L_1 T_1 L_2 T_2	1990, 2022
4.C.1 Net Grassland Remaining Grassland	CO_2	24.4	13.4	•	L_1 T_1 L_2 T_2	1990, 2022_2
4.D.2 Net Lands Converted to Wetlands	CO_2	4.1	0.3			
4.D.1 Net Coastal Wetlands Remaining Coastal Wetlands	CO_2	(+)	(10.6)			
4.B.1 Net Cropland Remaining Cropland	CO_2	(+)	(31.7)	•	L_1 T_1 L_2 T_2	1990_2, 2022
4.A.2 Net Land Converted to Forest Land	CO_2	(+)	(100.3)	•	L_1 L_2	1990, 2022
4.E.1 Net Settlements Remaining Settlements	CO_2	(+)	(134.8)	•	L_1 T_1 L_2 T_2	1990, 2022
4.A.1 Net Forest Land Remaining Forest Land	CO_2	(+)	(787.0)	•	L_1 T_1 L_2 T_2	1990, 2022
4.D.1 Flooded Lands Remaining Flooded Lands	CH_4	42.3	44.2	•	L_1	1990_1, 2022_1
4.A.1 Forest Fires	CH_4	3.4	9.1			
4.D.1 Coastal Wetlands Remaining Coastal Wetlands	CH_4	4.2	4.3			
4.C.1 Grass Fires	CH_4	0.1	0.3			
4.D.2 Land Converted to Flooded Lands	CH_4	2.9	0.2			
4.D.2 Land Converted to Coastal Wetlands	CH_4	0.3	0.2			
4.A.4 Drained Organic Soils	CH_4	+	+			
4.D.1 Peatlands Remaining Peatlands	CH_4	+	+			
4.A.1 Forest Fires	N_2O	2.4	5.7			
4.E.1 Settlement Soils	N_2O	2.1	2.5			
4.A.1 Forest Soils	N_2O	0.1	0.4			
4.C.1 Grass Fires	N_2O	0.1	0.3			
4.D.1 Coastal Wetlands Remaining Coastal Wetlands	N_2O	0.1	0.1			
4.A.4 Drained Organic Soils	N_2O	0.1	0.1			
4.D.1 Peatlands Remaining Peatlands	N_2O	+	+			

+ Absolute value does not exceed 0.05 MMT CO_2 Eq.

NO (Not Occurring)

[a] If the source is a key category for both L_1 and L_2 (as designated in the ID criteria column), it is a key category for both assessments in the years provided unless noted by a subscript, in which case it is a key category only for that assessment in only that year (e.g., 1990_2 designates a category is key for the Approach 2 assessment only in 1990).

Note: Parentheses indicate negative values (or sequestration).

References

IPCC (2019) *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.* The Intergovernmental Panel on Climate Change. [Calvo Buendia, E., Tanabe, K., Kranjc, A., Baasansuren, J., Fukuda, M., Ngarize, S., Osako, A., Pyrozhenko, Y., Shermanau, P. and Federici, S. (eds.)]. Published: IPCC, Switzerland.

IPCC (2006) Volume 1, Chapter 4: Methodological Choice and Identification of Key Categories, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. The National Greenhouse Gas Inventories Programme, The Intergovernmental Panel on Climate Change, H.S. Eggleston, L. Buendia, K. Miwa, T Negara, and K. Tanabe (eds.). Hayman, Kanagawa, Japan.