ANNEX 1 Key Category Analysis

The United States has identified national key categories based on the estimates presented in this report. The *2006 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) describes a key category as a "[category] that is prioritized within the national inventory system because its estimate has a significant influence on a country's total inventory of greenhouse gases in terms of the absolute level, the trend, or the uncertainty in emissions and removals." By definition, key categories are sources or sinks that have the greatest contribution to the absolute overall level of national emissions in any of the years covered by the time series. In addition, when an entire time series of emission 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 which significant uncertainty in the estimate would have considerable effects on overall emission trends. 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.

The methodology for conducting a key category analysis, as defined by the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006), 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 to identifying key categories; provides level and trend assessment equations; and provides a brief statistical evaluation of IPCC's quantitative methodologies for defining key categories. Table A-1 presents the key categories for the United States (including and excluding LULUCF categories) using emissions and uncertainty data in this report, and ranked according to their sector and global warming potential (GWP)-weighted emissions in 2016. The table also indicates the criteria used in identifying these categories (i.e., level, trend, Approach 1, Approach 2, and/or qualitative assessments).

Table A-1: Key Source Categories for the United States (1990-2016)

IPCC Source/Sink Categories	Greenhouse Gas	Approach 1				Approach 2				Qual[a]	2016 Emissions (MMT CO_2 Eq.)
		Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF	Level Without LULUCF	Trend Without LULUCF	Level With LULUCF	Trend With LULUCF		
Energy											
CO_2 Emissions from Mobile Combustion: Road	CO_2	•	•	•	•	•	•	•	•		1,496.0
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	•	•	•	•	•	•	•	•		1,241.4
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	•	•	•	•	•	•	•	•		546.0
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	•	•	•	•	•	•	•	•		477.9
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	•	•	•	•	•	•	•	•		272.5
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	•		•		•		•			238.3
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	•	•	•	•	•	•	•			170.3
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	•	•	•	•	•		•			167.4
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	•	•	•	•	•	•	•			112.2
CO_2 Emissions from Mobile Combustion: Other	CO_2	•		•							80.2
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	•	•	•	•						58.7
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	•	•	•	•	•	•	•	•		58.7
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	•	•	•	•	•	•				54.2
CO_2 Emissions from Mobile Combustion: Marine	CO_2	•	•	•	•						39.0
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	•	•	•	•						34.3
CO_2 Emissions from Natural Gas Systems	CO_2	•		•							25.5
CO_2 Emissions from Petroleum Systems	CO_2		•	•	•	•	•		•		22.8

CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	•	•	•	•	•	•		•		21.4
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2						•				3.0
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2		•		•						2.2
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2						•				0.0
CH_4 Emissions from Natural Gas Systems	CH_4	•	•	•	•	•	•	•	•		163.5
Fugitive Emissions from Coal Mining	CH_4	•	•	•	•	•	•	•	•		53.8
CH_4 Emissions from Petroleum Systems	CH_4	•		•		•		•			38.6
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4					•		•			7.1
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4					•	•	•	•		3.4
CH_4 Emissions from Mobile Combustion: Other	CH_4						•				2.1
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O		•		•	•	•				14.9
N_2O Emissions from Mobile Combustion: Road	N_2O	•	•	•	•	•	•				13.2
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O					•					2.5
International Bunker Fuels[b]	Several									•	117.7
Industrial Processes and Product Use											
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	•	•	•	•	•	•	•	•		42.3
CO_2 Emissions from Cement Production	CO_2	•		•							39.4
CO_2 Emissions from Petrochemical Production	CO_2	•	•	•	•						28.1
N_2O Emissions from Adipic Acid Production	N_2O		•		•						7.0
Emissions from Substitutes for Ozone Depleting Substances	HiGWP	•	•	•	•	•	•	•	•		159.1
SF_6 Emissions from Electrical Transmission and Distribution	HiGWP		•		•		•				4.3
HFC-23 Emissions from HCFC-22 Production	HiGWP	•	•	•	•		•		•		2.8

PFC Emissions from Aluminum Production	HiGWP		•		•		•					1.4
Agriculture												
CH_4 Emissions from Enteric Fermentation	CH_4	•		•		•		•				170.1
CH_4 Emissions from Manure Management	CH_4	•	•	•	•	•	•	•	•			67.7
CH_4 Emissions from Rice Cultivation	CH_4					•	•					13.7
Direct N_2O Emissions from Agricultural Soil Management	N_2O	•	•	•	•	•	•	•				237.6
Indirect N_2O Emissions from Applied Nitrogen	N_2O	•	•	•	•	•	•	•	•			45.9
Waste												
CH_4 Emissions from Landfills	CH_4	•	•	•	•	•	•	•	•			107.7
Land Use, Land Use Change, and Forestry												
Net CO_2 Emissions from Land Converted to Settlements	CO_2			•	•			•	•			68.0
Net CO_2 Emissions from Land Converted to Cropland	CO_2			•	•			•	•			23.8
CO_2 Emissions from Land Converted to Grassland	CO_2							•	•			22.0
Net CO_2 Emissions from Grassland Remaining Grassland	CO_2							•	•			(1.6)
Net CO_2 Emissions from Cropland Remaining Cropland	CO_2			•	•			•	•			(9.9)
Net CO_2 Emissions from Land Converted to Forest Land	CO_2			•	•							(75.0)
Net CO_2 Emissions from Settlements Remaining Settlements	CO_2			•	•			•	•			(103.7)
Net CO_2 Emissions from Forest Land Remaining Forest Land	CO_2			•	•			•	•			(670.5)
CH_4 Emissions from Forest Fires	CH_4				•			•	•			18.5
N_2O Emissions from Forest Fires	N_2O				•			•	•			12.2
Subtotal Without LULUCF												**6,348.5**
Total Emissions Without LULUCF												**6,511.3**
Percent of Total Without LULUCF												**97%**
Subtotal With LULUCF												**5,610.8**
Total Emissions With LULUCF												**5,794.5**
Percent of Total With LULUCF												**97%**

[a] Qualitative criteria.
[b] Emissions from this source not included in totals.
Note: Parentheses indicate negative values (or sequestration).

Table A-2 provides a complete listing of source categories by IPCC sector, along with notations on the criteria used in identifying key categories, without LULUCF sources and sinks. Similarly, Table A-3 provides a complete listing of source and sink categories by IPCC 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 2016) in which each source or sink category reached the threshold for being a key category based on either a Tier 1 or Tier 2 level assessment.

In addition to conducting Approach 1 and 2 level and trend assessments, a qualitative assessment of the source categories, as described in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006), 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 update its qualitative assessment on an annual basis.

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

IPCC Source Categories	Direct Greenhouse Gas	2016 Emissions (MMT CO_2 Eq.)	Key Category?	ID Criteria[a]	Level in which year(s)?[b]
Energy					
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,496.0	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,241.4	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	546.0	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	477.9	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	272.5	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.3	•	L_1 L_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	170.3	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	167.4	•	L_1 T_1 L_2	1990, 2016
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	112.2	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Mobile Combustion: Other	CO_2	80.2	•	L_1	1990_1, 2016_1
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	58.7	•	L_1 T_1	1990_1, 2016_1
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	58.7	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	54.2	•	L_1 T_1 L_2 T_2	1990, 2016_1
CO_2 Emissions from Mobile Combustion: Marine	CO_2	39.0	•	L_1 T_1	1990_1, 2016_1
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	34.3	•	L_1 T_1	1990_1, 2016_1
CO_2 Emissions from Natural Gas Systems	CO_2	25.5	•	L_1	1990_1
CO_2 Emissions from Petroleum Systems	CO_2	22.8	•	T_1 L_2 T_2	2016_2
CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	21.4	•	L_1 T_1 L_2 T_2	1990
CO_2 Emissions from Incineration of Waste	CO_2	10.7			
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	4.0			
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	3.0	•	T_2	
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	2.2	•	T_1	
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4			
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+			
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	0.0	•	T_2	
CH_4 Emissions from Natural Gas Systems	CH_4	163.5	•	L_1 T_1 L_2 T_2	1990, 2016

Fugitive Emissions from Coal Mining	CH_4	53.8	•	L_1 T_1 L_2 T_2	1990, 2016
CH_4 Emissions from Petroleum Systems	CH_4	38.6	•	L_1 L_2	1990, 2016
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	7.1	•	L_2	1990_2, 2016_2
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	6.7			
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	3.4	•	L_2 T_2	1990_2, 2016_2
CH_4 Emissions from Mobile Combustion: Other	CH_4	2.1	•	T_2	
Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.6			
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.2			
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	1.1			
CH_4 Emissions from Mobile Combustion: Road	CH_4	1.1			
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.3			
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	0.1			
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	+			
CH_4 Emissions from Incineration of Waste	CH_4	+			
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	14.9	•	T_1 L_2 T_2	2016_2
N_2O Emissions from Mobile Combustion: Road	N_2O	13.2	•	L_1 T_1 L_2 T_2	1990
N_2O Emissions from Mobile Combustion: Other	N_2O	3.2			
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	2.5	•	L_2	1990_2
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.5			
Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	0.7			
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.5			
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.3			
N_2O Emissions from Incineration of Waste	N_2O	0.3			
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1			
International Bunker Fuels[c]	Several	117.7	•		
Industrial Processes and Product Use					
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	42.3	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Cement Production	CO_2	39.4	•	L_1	1990_1, 2016_1
CO_2 Emissions from Petrochemical Production	CO_2	28.1	•	L_1 T_1	2016_1
CO_2 Emissions from Lime Production	CO_2	12.9			
CO_2 Emissions from Ammonia Production	CO_2	12.2			
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	11.0			
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	4.5			
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	4.0			
CO_2 Emissions from Ferroalloy Production	CO_2	1.8			
CO_2 Emissions from Soda Ash Production	CO_2	1.7			
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.6			
CO_2 Emissions from Aluminum Production	CO_2	1.3			
CO_2 Emissions from Glass Production	CO_2	1.2			
CO_2 Emissions from Phosphoric Acid Production	CO_2	1.0			
CO_2 Emissions from Zinc Production	CO_2	0.9			
CO_2 Emissions from Lead Production	CO_2	0.5			
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.2			

CO_2 Emissions from Magnesium Production and Processing	CO_2	+			
CH_4 Emissions from Petrochemical Production	CH_4	0.2			
CH_4 Emissions from Ferroalloy Production	CH_4	+			
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+			
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+			
N_2O Emissions from Nitric Acid Production	N_2O	10.2			
N_2O Emissions from Adipic Acid Production	N_2O	7.0	•	T_1	
N_2O Emissions from Product Uses	N_2O	4.2			
N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	2.0			
N_2O Emissions from Semiconductor Manufacture	N_2O	0.2			
Emissions from Substitutes for Ozone Depleting Substances	HiGWP	159.1	•	L_1 T_1 L_2 T_2	2016
PFC, HFC, SF_6, and NF_3 Emissions from Semiconductor Manufacture	HiGWP	4.7			
SF_6 Emissions from Electrical Transmission and Distribution	HiGWP	4.3	•	T_1 T_2	
HFC-23 Emissions from HCFC-22 Production	HiGWP	2.8	•	L_1 T_1 T_2	1990_1
PFC Emissions from Aluminum Production	HiGWP	1.4	•	T_1 T_2	
SF_6 Emissions from Magnesium Production and Processing	HiGWP	1.0			
HFC-134a Emissions from Magnesium Production and Processing	HiGWP	0.1			
Agriculture					
CO_2 Emissions from Urea Fertilization	CO_2	5.1			
CO_2 Emissions from Liming	CO_2	3.9			
CH_4 Emissions from Enteric Fermentation	CH_4	170.1	•	L_1 L_2	1990, 2016
CH_4 Emissions from Manure Management	CH_4	67.7	•	L_1 T_1 L_2 T_2	1990, 2016
CH_4 Emissions from Rice Cultivation	CH_4	13.7	•	L_2 T_2	1990_2, 2016_2
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.3			
Direct N_2O Emissions from Agricultural Soil Management	N_2O	237.6	•	L_1 T_1 L_2 T_2	1990, 2016
Indirect N_2O Emissions from Applied Nitrogen	N_2O	45.9	•	L_1 T_1 L_2 T_2	1990, 2016
N_2O Emissions from Manure Management	N_2O	18.1			
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1			
Waste					
CH_4 Emissions from Landfills	CH_4	107.7	•	L_1 T_1 L_2 T_2	1990, 2016
CH_4 Emissions from Wastewater Treatment	CH_4	14.8			
CH_4 Emissions from Composting	CH_4	2.1			
N_2O Emissions from Wastewater Treatment	N_2O	5.0			
N_2O Emissions from Composting	N_2O	1.9			

+ Does not exceed 0.05 MMT CO_2 Eq.

[a] For the ID criteria, Q refers to "Qualitative", L refers to a key category identified through a level assessment; T refers to a key category identified through a trend assessment and the subscripted number refers to either an Approach 1 or Approach 2 assessment (e.g., L_2 designates a source is a key category for an Approach 2 level assessment).

[b] 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 source is a key category for the Approach 2 assessment only in 1990).

[c] Emissions from these sources not included in totals.

Note: LULUCF sources and sinks are not included in this analysis.

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

IPCC Source/Sink Categories	Direct Greenhouse Gas	2016 Emissions (MMT CO_2 Eq.)	Key Category?	ID Criteria[a]	Level in which year(s)?[b]
Energy					
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,496.0	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,241.4	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	546.0	•	L_1 T_1 L_2 T_2	1990_1, 2016
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	477.9	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	272.5	•	L_1 T_1 L_2 T_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.3	•	L_1 L_2	1990, 2016
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	170.3	•	L_1 T_1 L_2	1990_1, 2016
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	167.4	•	L_1 T_1 L_2	1990, 2016_1
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	112.2	•	L_1 T_1 L_2	1990, 2016
CO_2 Emissions from Mobile Combustion: Other	CO_2	80.2	•	L_1	1990_1, 2016_1
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	58.7	•	L_1 T_1	1990_1, 2016_1
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	58.7	•	L_1 T_1 L_2 T_2	1990, 2016_1
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	54.2	•	L_1 T_1	1990_1, 2016_1
CO_2 Emissions from Mobile Combustion: Marine	CO_2	39.0	•	L_1 T_1	1990_1, 2016_1
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	34.3	•	L_1 T_1	1990_1, 2016_1
CO_2 Emissions from Natural Gas Systems	CO_2	25.5	•	L_1	1990_1, 2016_1
CO_2 Emissions from Petroleum Systems	CO_2	22.8	•	L_1 T_1 T_2	2016_1
CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	21.4	•	L_1 T_1 T_2	1990_1
CO_2 Emissions from Incineration of Waste	CO_2	10.7			
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	4.0			
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	3.0			
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	2.2	•	T_1	
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4			
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+			
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	0.0			
CH_4 Emissions from Natural Gas Systems	CH_4	163.5	•	L_1 T_1 L_2 T_2	1990, 2016
Fugitive Emissions from Coal Mining	CH_4	53.8	•	L_1 T_1 L_2 T_2	1990, 2016_1
CH_4 Emissions from Petroleum Systems	CH_4	38.6	•	L_1 L_2	1990, 2016
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	7.1	•	L_2	1990_2, 2016_2
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	6.7			
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	3.4	•	L_2 T_2	1990_2
CH_4 Emissions from Mobile Combustion: Other	CH_4	2.1			
Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.6			
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.2			

Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	1.1			
CH_4 Emissions from Mobile Combustion: Road	CH_4	1.1			
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.3			
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	0.1			
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	+			
CH_4 Emissions from Incineration of Waste	CH_4	+			
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	14.9	•	T_1	
N_2O Emissions from Mobile Combustion: Road	N_2O	13.2	•	L_1 T_1	1990_1
N_2O Emissions from Mobile Combustion: Other	N_2O	3.2			
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	2.5			
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.5			
Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	0.7			
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.5			
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.3			
N_2O Emissions from Incineration of Waste	N_2O	0.3			
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1			
International Bunker Fuels[c]	Several	117.7	•		
Industrial Processes and Product Use					
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	42.3	•	L_1 T_1 L_2 T_2	$1990, 2016_1$
CO_2 Emissions from Cement Production	CO_2	39.4	•	L_1	$1990_1, 2016_1$
CO_2 Emissions from Petrochemical Production	CO_2	28.1	•	L_1 T_1	2016_1
CO_2 Emissions from Lime Production	CO_2	12.9			
CO_2 Emissions from Ammonia Production	CO_2	12.2			
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	11.0			
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	4.5			
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	4.0			
CO_2 Emissions from Ferroalloy Production	CO_2	1.8			
CO_2 Emissions from Soda Ash Production	CO_2	1.7			
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.6			
CO_2 Emissions from Aluminum Production	CO_2	1.3			
CO_2 Emissions from Glass Production	CO_2	1.2			
CO_2 Emissions from Phosphoric Acid Production	CO_2	1.0			
CO_2 Emissions from Zinc Production	CO_2	0.9			
CO_2 Emissions from Lead Production	CO_2	0.5			
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.2			
CO_2 Emissions from Magnesium Production and Processing	CO_2	+			
CH_4 Emissions from Petrochemical Production	CH_4	0.2			
CH_4 Emissions from Ferroalloy Production	CH_4	+			
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+			
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+			
N_2O Emissions from Nitric Acid Production	N_2O	10.2			
N_2O Emissions from Adipic Acid Production	N_2O	7.0	•	T_1	
N_2O Emissions from Product Uses	N_2O	4.2			

N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	2.0			
N_2O Emissions from Semiconductor Manufacture	N_2O	0.2			
Emissions from Substitutes for Ozone Depleting Substances	HiGWP	159.1	•	L_1 T_1 L_2 T_2	2016
PFC, HFC, SF_6, and NF_3 Emissions from Semiconductor Manufacture	HiGWP	4.7			
SF_6 Emissions from Electrical Transmission and Distribution	HiGWP	4.3	•	T_1	
HFC-23 Emissions from HCFC-22 Production	HiGWP	2.8	•	L_1 T_1 T_2	1990_1
PFC Emissions from Aluminum Production	HiGWP	1.4	•	T_1	
SF_6 Emissions from Magnesium Production and Processing	HiGWP	1.0			
HFC-134a Emissions from Magnesium Production and Processing	HiGWP	0.1			
Agriculture					
CO_2 Emissions from Urea Fertilization	CO_2	5.1			
CO_2 Emissions from Liming	CO_2	3.9			
CH_4 Emissions from Enteric Fermentation	CH_4	170.1	•	L_1 L_2	1990, 2016
CH_4 Emissions from Manure Management	CH_4	67.7	•	L_1 T_1 L_2 T_2	1990_1, 2016
CH_4 Emissions from Rice Cultivation	CH_4	13.7			
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.3			
Direct N_2O Emissions from Agricultural Soil Management	N_2O	237.6	•	L_1 T_1 L_2	1990, 2016
Indirect N_2O Emissions from Applied Nitrogen	N_2O	45.9	•	L_1 T_1 L_2 T_2	1990, 2016
N_2O Emissions from Manure Management	N_2O	18.1			
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1			
Waste					
CH_4 Emissions from Landfills	CH_4	107.7	•	L_1 T_1 L_2 T_2	1990, 2016
CH_4 Emissions from Wastewater Treatment	CH_4	14.8			
CH_4 Emissions from Composting	CH_4	2.1			
N_2O Emissions from Wastewater Treatment	N_2O	5.0			
N_2O Emissions from Composting	N_2O	1.9			
Land Use, Land Use Change, and Forestry					
Net CO_2 Emissions from Land Converted to Settlements	CO_2	68.0	•	L_1 T_1 L_2 T_2	1990_1, 2016
Net CO_2 Emissions from Land Converted to Cropland	CO_2	23.8	•	L_1 T_1 L_2 T_2	1990, 2016
Net CO_2 Emissions from Land Converted to Grassland	CO_2	22.0	•	L_2 T_2	1990_2, 2016_2
Net CO_2 Emissions from Land Converted to Wetlands	CO_2	(+)			
Net CO_2 Emissions from Grassland Remaining Grassland	CO_2	(+)	•	L_2 T_2	1990_2, 2016_2
Net CO_2 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CO_2	(+)			
Net CO_2 Emissions from Cropland Remaining Cropland	CO_2	(+)	•	L_1 T_1 L_2 T_2	1990, 2016_2
Net CO_2 Emissions from Land Converted to Forest Land	CO_2	(+)	•	L_1 T_1	1990_1, 2016_1
Net CO_2 Emissions from Settlements Remaining Settlements	CO_2	(+)	•	L_1 T_1 L_2 T_2	1990, 2016
Net CO_2 Emissions from Forest Land Remaining Forest Land	CO_2	(+)	•	L_1 T_1 L_2 T_2	1990, 2016
CH_4 Emissions from Forest Fires	CH_4	18.5	•	T_1 L_2 T_2	2016_2
CH_4 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CH_4	3.6			

CH_4 Emissions from Grass Fires	CH_4	0.3			
CH_4 Emissions from Drained Organic Soils	CH_4	+			
CH_4 Emissions from Land Converted to Coastal Wetlands	CH_4	+			
CH_4 Emissions from Peatlands Remaining Peatlands	CH_4	+			
N_2O Emissions from Forest Fires	N_2O	12.2	•	T_1 L_2 T_2	2016_2
N_2O Emissions from Settlement Soils	N_2O	2.5			
N_2O Emissions from Forest Soils	N_2O	0.5			
N_2O Emissions from Grass Fires	N_2O	0.3			
N_2O Emissions from Coastal Wetlands Remaining Coastal Wetlands	N_2O	0.1			
N_2O Emissions from Drained Organic Soils	N_2O	0.1			
N_2O Emissions from Peatlands Remaining Peatlands	N_2O	+			

+ Does not exceed 0.05 MMT CO_2 Eq.

[a] For the ID criteria, Q refers to "Qualitative," L refers to a key category identified through a level assessment; T refers to a key category identified through a trend assessment and the subscripted number refers to either an Approach 1 or Approach 2 assessment (e.g., L_2 designates a source is a key category for an Approach 2 level assessment).

[b] 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 source is a key category for the Approach 2 assessment only in 1990).

[c] Emissions from these sources not included in totals.

Note: Parentheses indicate negative values (or sequestration).

Evaluation of Key Categories

Level Assessment

When using an Approach 1 for the level assessment, a predetermined cumulative emissions threshold is used to identify key categories. When source and sink categories are sorted in order of decreasing absolute emissions, those that fall at the top of the list and cumulatively account for 95 percent of emissions are considered key categories. The 95 percent threshold in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) was designed to establish a general level where the key category analysis covers approximately 75 to 92 percent of inventory uncertainty.

Including the Approach 2 provides additional insight into why certain source categories are considered key, and how to prioritize inventory improvements. In the Approach 2, the level assessment for each category from the Approach 1 is multiplied by its percent relative uncertainty. If the uncertainty reported is asymmetrical, the absolute value of the larger uncertainty is used. While CO_2 emissions from geothermal energy are included in the overall emissions estimate, they are not an official IPCC source category. As a result, there are no guidelines to associate uncertainty with the emissions estimate; therefore, an uncertainty analysis was not conducted. The uncertainty associated with CO_2 from mobile combustion is applied to each mode's emission estimate. No uncertainty was associated with CH_4 emissions from waste incineration because emissions are less than 0.05 kt CH_4 and an uncertainty analysis was not conducted. 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 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, keeping in mind that the two assessments are not mutually exclusive.

It is important to note that a key category analysis can be sensitive to the definitions of the source and sink categories. If a large source or sink category is split into many subcategories, then the subcategories may have contributions to the total inventory that are too small for those source categories to be considered key. Similarly, a collection of small, non-key source categories adding up to less than 5 percent of total emissions could become key source categories if those source categories were aggregated into a single source or sink category. The United States has attempted to define source and sink categories by the conventions that would allow comparison with other international key categories, while 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. Additionally, the United States accounts for some source categories, including fossil fuel feedstocks, international bunkers, and emissions from U.S. Territories, that are derived from unique data sources using country-specific methodologies.

Table A-4 through Table A-7 contain the 1990 and 2016 level assessments for both with and without LULUCF sources and sinks, and contain further detail on where each source falls within the analysis. Approach 1 key categories are shaded dark gray. Additional key categories identified by the Approach 2 assessment are shaded light gray.

Trend Assessment

Approach 1 for trend assessment is defined as the product of the source or sink category level assessment and the absolute difference between the source or sink category trend and the total trend. In turn, the source or sink category trend is defined as the change in emissions from the base year to the current year, as a percentage of current year emissions from that source or sink category. The total trend is the percentage change in total inventory emissions 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. To determine key categories, the trend assessments are sorted in decreasing order, so that the source or sink categories with the highest trend assessments appear first. The trend assessments are summed until the threshold of 95 percent is reached; 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. 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 key categories identified by the Approach 2 trend 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, keeping in mind that the two assessments are not mutually exclusive.

Table A-8 and Table A-9 contain the 1990 through 2016 trend assessment for both with and without LULUCF sources and sinks, and contain further detail on where each source falls within the analysis. Approach 1 key categories are shaded dark gray. Additional key categories identified by the Approach 2 assessment are shaded light gray.

Table A-4: 1990 Key Source Category Approach 1 and Approach 2 Analysis—Level Assessment, without LULUCF

IPCC Source Categories	Direct Greenhouse Gas	1990 Estimate (MMT CO_2 Eq.)	Approach 1 Level Assessment	Cumulative Total	Uncertainty[a]	Approach 2 Level Assessment
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,547.6	0.24	0.24	10%	0.023
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,162.7	0.18	0.43	6%	0.012
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	408.9	0.06	0.49	7%	0.005
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	294.7	0.05	0.54	21%	0.010
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.0	0.04	0.57	7%	0.003
Direct N_2O Emissions from Agricultural Soil Management	N_2O	212.0	0.03	0.61	16%	0.005
CH_4 Emissions from Natural Gas Systems	CH_4	195.2	0.03	0.64	17%	0.005
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	187.4	0.03	0.67	6%	0.002
CH_4 Emissions from Landfills	CH_4	179.6	0.03	0.70	23%	0.007
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	175.3	0.03	0.72	5%	0.001
CH_4 Emissions from Enteric Fermentation	CH_4	164.2	0.03	0.75	18%	0.005
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	155.3	0.02	0.77	16%	0.004
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	142.1	0.02	0.80	7%	0.002
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	119.5	0.02	0.82	39%	0.007
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	101.6	0.02	0.83	17%	0.003
CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	0.02	0.85	9%	0.001
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	97.4	0.02	0.86	6%	0.001

Fugitive Emissions from Coal Mining	CH_4	96.5	0.02	0.88	14%	0.002
CO_2 Emissions from Mobile Combustion: Other	CO_2	73.2	0.01	0.89	6%	0.001
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	73.1	0.01	0.90	6%	0.001
HFC-23 Emissions from HCFC-22 Production	HFCs	46.1	0.01	0.91	10%	0.001
CO_2 Emissions from Mobile Combustion: Marine	CO_2	44.3	0.01	0.91	6%	<0.001
CH_4 Emissions from Petroleum Systems	CH_4	39.8	0.01	0.92	34%	0.002
Indirect N_2O Emissions from Applied Nitrogen	N_2O	38.5	0.01	0.93	154%	0.009
N_2O Emissions from Mobile Combustion: Road	N_2O	37.6	0.01	0.93	14%	0.001
CH_4 Emissions from Manure Management	CH_4	37.2	0.01	0.94	20%	0.001
CO_2 Emissions from Cement Production	CO_2	33.5	0.01	0.94	6%	<0.001
CO_2 Emissions from Natural Gas Systems	CO_2	29.8	<0.01	0.95	17%	0.001
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	26.9	<0.01	0.95	11%	<0.001
SF_6 Emissions from Electrical Transmission and Distribution	SF_6	23.1	<0.01	0.96	14%	0.001
PFC Emissions from Aluminum Production	PFCs	21.5	<0.01	0.96	8%	<0.001
CO_2 Emissions from Petrochemical Production	CO_2	21.2	<0.01	0.96	5%	<0.001
CH_4 Emissions from Rice Cultivation	CH_4	16.0	<0.01	0.97	64%	0.002
CH_4 Emissions from Wastewater Treatment	CH_4	15.7	<0.01	0.97	27%	0.001
N_2O Emissions from Adipic Acid Production	N_2O	15.2	<0.01	0.97	5%	<0.001
N_2O Emissions from Manure Management	N_2O	14.0	<0.01	0.97	24%	0.001
CO_2 Emissions from Ammonia Production	CO_2	13.0	<0.01	0.97	7%	<0.001
N_2O Emissions from Nitric Acid Production	N_2O	12.1	<0.01	0.98	5%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	12.0	<0.01	0.98	15%	<0.001
CO_2 Emissions from Lime Production	CO_2	11.7	<0.01	0.98	2%	<0.001
CO_2 Emissions from Incineration of Waste	CO_2	8.0	<0.01	0.98	26%	<0.001
CO_2 Emissions from Petroleum Systems	CO_2	7.7	<0.01	0.98	34%	<0.001
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	7.2	<0.01	0.98	22%	<0.001
CH_4 Emissions from Mobile Combustion: Other	CH_4	7.0	<0.01	0.99	50%	0.001
CO_2 Emissions from Aluminum Production	CO_2	6.8	<0.01	0.99	3%	<0.001
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	6.5	<0.01	0.99	215%	0.002
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	6.5	<0.01	0.99	43%	<0.001
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	6.3	<0.01	0.99	15%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	5.2	<0.01	0.99	227%	0.002
CH_4 Emissions from Mobile Combustion: Road	CH_4	5.2	<0.01	0.99	26%	<0.001
SF_6 Emissions from Magnesium Production and Processing	SF_6	5.2	<0.01	0.99	6%	<0.001
CO_2 Emissions from Liming	CO_2	4.7	<0.01	0.99	111%	0.001
N_2O Emissions from Product Uses	N_2O	4.2	<0.01	0.99	24%	<0.001
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	3.8	<0.01	0.99	12%	<0.001
PFC, HFC, SF_6, and NF_3 Emissions from Semiconductor Manufacture	Several	3.6	<0.01	0.99	6%	<0.001
N_2O Emissions from Wastewater Treatment	N_2O	3.4	<0.01	0.99	112%	0.001
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	3.1	<0.01	1.00	206%	0.001
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	3.0	<0.01	1.00	NE	<0.001
CO_2 Emissions from Urea Fertilization	CO_2	2.4	<0.01	1.00	43%	<0.001
CO_2 Emissions from Ferroalloy Production	CO_2	2.2	<0.01	1.00	12%	<0.001

Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.8	<0.01	1.00	50%	<0.001
N_2O Emissions from Mobile Combustion: Other	N_2O	1.8	<0.01	1.00	59%	<0.001
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.7	<0.01	1.00	67%	<0.001
N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.7	<0.01	1.00	31%	<0.001
CO_2 Emissions from Glass Production	CO_2	1.5	<0.01	1.00	4%	<0.001
CO_2 Emissions from Phosphoric Acid Production	CO_2	1.5	<0.01	1.00	21%	<0.001
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	1.5	<0.01	1.00	5%	<0.001
CO_2 Emissions from Soda Ash Production	CO_2	1.4	<0.01	1.00	9%	<0.001
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.2	<0.01	1.00	13%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.1	<0.01	1.00	145%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	1.0	<0.01	1.00	212%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	0.6	<0.01	1.00	19%	<0.001
CO_2 Emissions from Zinc Production	CO_2	0.6	<0.01	1.00	16%	<0.001
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.6	<0.01	1.00	46%	<0.001
CO_2 Emissions from Lead Production	CO_2	0.5	<0.01	1.00	15%	<0.001
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.5	<0.01	1.00	85%	<0.001
N_2O Emissions from Incineration of Waste	N_2O	0.5	<0.01	1.00	327%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	0.4	<0.01	1.00	4%	<0.001
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4	<0.01	1.00	NA	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.4	<0.01	1.00	176%	<0.001
CH_4 Emissions from Composting	CH_4	0.4	<0.01	1.00	50%	<0.001
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.4	<0.01	1.00	9%	<0.001
N_2O Emissions from Composting	N_2O	0.3	<0.01	1.00	50%	<0.001
Emissions from Substitutes for Ozone Depleting Substances	Several	0.3	<0.01	1.00	12%	<0.001
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.2	<0.01	1.00	14%	<0.001
CH_4 Emissions from Petrochemical Production	CH_4	0.2	<0.01	1.00	57%	<0.001
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	<0.01	1.00	14%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1	<0.01	1.00	198%	<0.001
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	0.1	<0.01	1.00	88%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	+	<0.01	1.00	55%	<0.001
N_2O Emissions from Semiconductor Manufacture	N_2O	+	<0.01	1.00	12%	<0.001
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+	<0.01	1.00	10%	<0.001
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+	<0.01	1.00	20%	<0.001
CH_4 Emissions from Ferroalloy Production	CH_4	+	<0.01	1.00	12%	<0.001
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+	<0.01	1.00	215%	<0.001
CO_2 Emissions from Magnesium Production and Processing	CO_2	+	<0.01	1.00	2%	<0.001
CH_4 Emissions from Incineration of Waste	CH_4	+	<0.01	1.00	NE	<0.001
HFC-134a Emissions from Magnesium Production and Processing	HFCs	0.0	<0.01	1.00	4%	<0.001
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	0.0	<0.01	1.00	17%	<0.001

+ Does not exceed 0.05 MMT CO_2 Eq.
NE (Not Estimated)
NA (Not Available)
[a] Percent relative uncertainty. If the corresponding uncertainty is asymmetrical, the uncertainty given here is the larger and always positive.
Note: LULUCF sources and sinks are not included in this analysis.

Table A-5: 1990 Key Source Category Approach 1 and Approach 2 Analysis—Level Assessment, with LULUCF

IPCC Source/Sink Categories	Direct Greenhouse Gas	1990 Estimate (MMT CO_2 Eq.)	Approach 1 Level Assessment	Cumulative Total	Uncertainty[a]	Approach 2 Level Assessment
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,547.6	0.21	0.21	10%	0.020
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,162.7	0.16	0.37	6%	0.010
Net CO_2 Emissions from Forest Land Remaining Forest Land	CO_2	697.7	0.09	0.46	78%	0.073
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	408.9	0.06	0.52	7%	0.004
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	294.7	0.04	0.56	21%	0.008
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.0	0.03	0.59	7%	0.002
Direct N_2O Emissions from Agricultural Soil Management	N_2O	212.0	0.03	0.62	16%	0.005
CH_4 Emissions from Natural Gas Systems	CH_4	195.2	0.03	0.64	17%	0.004
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	187.4	0.03	0.67	6%	0.002
CH_4 Emissions from Landfills	CH_4	179.6	0.02	0.69	23%	0.006
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	175.3	0.02	0.72	5%	0.001
CH_4 Emissions from Enteric Fermentation	CH_4	164.2	0.02	0.74	18%	0.004
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	155.3	0.02	0.76	16%	0.003
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	142.1	0.02	0.78	7%	0.001
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	119.5	0.02	0.80	39%	0.006
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	101.6	0.01	0.81	17%	0.002
CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	0.01	0.82	9%	0.001
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	97.4	0.01	0.84	6%	0.001
Fugitive Emissions from Coal Mining	CH_4	96.5	0.01	0.85	14%	0.002
Net CO_2 Emissions from Land Converted to Forest Land	CO_2	92.0	0.01	0.86	11%	0.001
Net CO_2 Emissions from Settlements Remaining Settlements	CO_2	86.2	0.01	0.87	85%	0.010
CO_2 Emissions from Mobile Combustion: Other	CO_2	73.2	0.01	0.88	6%	0.001
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	73.1	0.01	0.89	6%	0.001
HFC-23 Emissions from HCFC-22 Production	HFCs	46.1	0.01	0.90	10%	0.001
CO_2 Emissions from Mobile Combustion: Marine	CO_2	44.3	0.01	0.90	6%	<0.001
Net CO_2 Emissions from Land Converted to Cropland	CO_2	43.3	0.01	0.91	77%	0.005
Net CO_2 Emissions from Cropland Remaining Cropland	CO_2	40.9	0.01	0.92	452%	0.025
CH_4 Emissions from Petroleum Systems	CH_4	39.8	0.01	0.92	34%	0.002
Indirect N_2O Emissions from Applied Nitrogen	N_2O	38.5	0.01	0.93	154%	0.008
N_2O Emissions from Mobile Combustion: Road	N_2O	37.6	0.01	0.93	14%	0.001
Net CO_2 Emissions from Land Converted to Settlements	CO_2	37.2	0.01	0.94	29%	0.001
CH_4 Emissions from Manure Management	CH_4	37.2	0.01	0.94	20%	0.001
CO_2 Emissions from Cement Production	CO_2	33.5	<0.01	0.95	6%	<0.001
CO_2 Emissions from Natural Gas Systems	CO_2	29.8	<0.01	0.95	17%	0.001

CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	26.9	<0.01	0.95	11%	<0.001
SF_6 Emissions from Electrical Transmission and Distribution	SF_6	23.1	<0.01	0.96	14%	<0.001
PFC Emissions from Aluminum Production	PFCs	21.5	<0.01	0.96	8%	<0.001
CO_2 Emissions from Petrochemical Production	CO_2	21.2	<0.01	0.96	5%	<0.001
Net CO_2 Emissions from Land Converted to Grassland	CO_2	17.9	<0.01	0.97	134%	0.003
CH_4 Emissions from Rice Cultivation	CH_4	16.0	<0.01	0.97	64%	0.001
CH_4 Emissions from Wastewater Treatment	CH_4	15.7	<0.01	0.97	27%	0.001
N_2O Emissions from Adipic Acid Production	N_2O	15.2	<0.01	0.97	5%	<0.001
N_2O Emissions from Manure Management	N_2O	14.0	<0.01	0.97	24%	<0.001
CO_2 Emissions from Ammonia Production	CO_2	13.0	<0.01	0.98	7%	<0.001
N_2O Emissions from Nitric Acid Production	N_2O	12.1	<0.01	0.98	5%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	12.0	<0.01	0.98	15%	<0.001
CO_2 Emissions from Lime Production	CO_2	11.7	<0.01	0.98	2%	<0.001
CO_2 Emissions from Incineration of Waste	CO_2	8.0	<0.01	0.98	26%	<0.001
CO_2 Emissions from Petroleum Systems	CO_2	7.7	<0.01	0.98	34%	<0.001
Net CO_2 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CO_2	7.6	<0.01	0.98	59%	0.001
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	7.2	<0.01	0.98	22%	<0.001
CH_4 Emissions from Mobile Combustion: Other	CH_4	7.0	<0.01	0.99	50%	<0.001
CO_2 Emissions from Aluminum Production	CO_2	6.8	<0.01	0.99	3%	<0.001
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	6.5	<0.01	0.99	215%	0.002
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	6.5	<0.01	0.99	43%	<0.001
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	6.3	<0.01	0.99	15%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	5.2	<0.01	0.99	227%	0.002
CH_4 Emissions from Mobile Combustion: Road	CH_4	5.2	<0.01	0.99	26%	<0.001
SF_6 Emissions from Magnesium Production and Processing	SF_6	5.2	<0.01	0.99	6%	<0.001
CO_2 Emissions from Liming	CO_2	4.7	<0.01	0.99	111%	0.001
N_2O Emissions from Product Uses	N_2O	4.2	<0.01	0.99	24%	<0.001
Net CO_2 Emissions from Grassland Remaining Grassland	CO_2	4.2	<0.01	0.99	2503%	0.014
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	3.8	<0.01	0.99	12%	<0.001
PFC, HFC, SF_6, and NF_3 Emissions from Semiconductor Manufacture	Several	3.6	<0.01	0.99	6%	<0.001
CH_4 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CH_4	3.4	<0.01	0.99	30%	<0.001
N_2O Emissions from Wastewater Treatment	N_2O	3.4	<0.01	0.99	112%	0.001
CH_4 Emissions from Forest Fires	CH_4	3.2	<0.01	0.99	127%	0.001
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	3.1	<0.01	1.00	206%	0.001
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	3.0	<0.01	1.00	NE	<0.001
CO_2 Emissions from Urea Fertilization	CO_2	2.4	<0.01	1.00	43%	<0.001
CO_2 Emissions from Ferroalloy Production	CO_2	2.2	<0.01	1.00	12%	<0.001
N_2O Emissions from Forest Fires	N_2O	2.1	<0.01	1.00	120%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.8	<0.01	1.00	50%	<0.001
N_2O Emissions from Mobile Combustion: Other	N_2O	1.8	<0.01	1.00	59%	<0.001
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.7	<0.01	1.00	67%	<0.001
N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.7	<0.01	1.00	31%	<0.001

CO_2 Emissions from Glass Production	CO_2	1.5	<0.01	1.00	4%	<0.001
CO_2 Emissions from Phosphoric Acid Production	CO_2	1.5	<0.01	1.00	21%	<0.001
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	1.5	<0.01	1.00	5%	<0.001
CO_2 Emissions from Soda Ash Production	CO_2	1.4	<0.01	1.00	9%	<0.001
N_2O Emissions from Settlement Soils	N_2O	1.4	<0.01	1.00	45%	<0.001
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.2	<0.01	1.00	13%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.1	<0.01	1.00	145%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	1.0	<0.01	1.00	212%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	0.6	<0.01	1.00	19%	<0.001
CO_2 Emissions from Zinc Production	CO_2	0.6	<0.01	1.00	16%	<0.001
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.6	<0.01	1.00	46%	<0.001
CO_2 Emissions from Lead Production	CO_2	0.5	<0.01	1.00	15%	<0.001
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.5	<0.01	1.00	85%	<0.001
N_2O Emissions from Incineration of Waste	N_2O	0.5	<0.01	1.00	327%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	0.4	<0.01	1.00	4%	<0.001
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4	<0.01	1.00	NA	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.4	<0.01	1.00	176%	<0.001
CH_4 Emissions from Composting	CH_4	0.4	<0.01	1.00	50%	<0.001
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.4	<0.01	1.00	9%	<0.001
N_2O Emissions from Composting	N_2O	0.3	<0.01	1.00	50%	<0.001
Emissions from Substitutes for Ozone Depleting Substances	Several	0.3	<0.01	1.00	12%	<0.001
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.2	<0.01	1.00	14%	<0.001
CH_4 Emissions from Petrochemical Production	CH_4	0.2	<0.01	1.00	57%	<0.001
N_2O Emissions from Coastal Wetlands Remaining Coastal Wetlands	N_2O	0.1	<0.01	1.00	116%	<0.001
N_2O Emissions from Drained Organic Soils	N_2O	0.1	<0.01	1.00	124%	<0.001
N_2O Emissions from Forest Soils	N_2O	0.1	<0.01	1.00	318%	<0.001
N_2O Emissions from Grass Fires	N_2O	0.1	<0.01	1.00	144%	<0.001
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	<0.01	1.00	14%	<0.001
CH_4 Emissions from Grass Fires	CH_4	0.1	<0.01	1.00	145%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1	<0.01	1.00	198%	<0.001
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	0.1	<0.01	1.00	88%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	+	<0.01	1.00	55%	<0.001
N_2O Emissions from Semiconductor Manufacture	N_2O	+	<0.01	1.00	12%	<0.001
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+	<0.01	1.00	10%	<0.001
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+	<0.01	1.00	20%	<0.001
Net CO_2 Emissions from Land Converted to Wetlands	CO_2	+	<0.01	1.00	30%	<0.001
CH_4 Emissions from Ferroalloy Production	CH_4	+	<0.01	1.00	12%	<0.001
CH_4 Emissions from Land Converted to Coastal Wetlands	CH_4	+	<0.01	1.00	30%	<0.001
CH_4 Emissions from Drained Organic Soils	CH_4	+	<0.01	1.00	76%	<0.001
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+	<0.01	1.00	215%	<0.001
CH_4 Emissions from Peatlands Remaining Peatlands	CH_4	+	<0.01	1.00	78%	<0.001

CO_2 Emissions from Magnesium Production and Processing	CO_2	+	<0.01	1.00	2%	<0.001
N_2O Emissions from Peatlands Remaining Peatlands	N_2O	+	<0.01	1.00	53%	<0.001
CH_4 Emissions from Incineration of Waste	CH_4	+	<0.01	1.00	NE	<0.001
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	0.0	<0.01	1.00	17%	<0.001
HFC-134a Emissions from Magnesium Production and Processing	HFCs	0.0	<0.01	1.00	4%	<0.001

+ Does not exceed 0.05 MMT CO_2 Eq.
NE (Not Estimated)
NA (Not Available)
[a] Percent relative uncertainty. If the corresponding uncertainty is asymmetrical, the uncertainty given here is the larger and always positive.

Table A-6: 2016 Key Source Category Approach 1 and Approach 2 Analysis—Level Assessment, without LULUCF

IPCC Source Categories	Direct Greenhouse Gas	2016 Estimate (MMT CO_2 Eq.)	Approach 1 Level Assessment	Cumulative Total	Uncertainty[a]	Approach 2 Level Assessment
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,496.0	0.23	0.23	6%	0.015
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,241.4	0.19	0.42	10%	0.018
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	546.0	0.08	0.50	5%	0.004
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	477.9	0.07	0.58	7%	0.005
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	272.5	0.04	0.62	21%	0.009
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.3	0.04	0.66	7%	0.003
Direct N_2O Emissions from Agricultural Soil Management	N_2O	237.6	0.04	0.69	16%	0.006
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	170.3	0.03	0.72	7%	0.002
CH_4 Emissions from Enteric Fermentation	CH_4	170.1	0.03	0.74	18%	0.005
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	167.4	0.03	0.77	6%	0.002
CH_4 Emissions from Natural Gas Systems	CH_4	163.5	0.03	0.80	17%	0.004
Emissions from Substitutes for Ozone Depleting Substances	Several	159.1	0.02	0.82	12%	0.003
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	112.2	0.02	0.84	39%	0.007
CH_4 Emissions from Landfills	CH_4	107.7	0.02	0.85	23%	0.004
CO_2 Emissions from Mobile Combustion: Other	CO_2	80.2	0.01	0.87	6%	0.001
CH_4 Emissions from Manure Management	CH_4	67.7	0.01	0.88	20%	0.002
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	58.7	0.01	0.89	6%	0.001
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	58.7	0.01	0.89	16%	0.001
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	54.2	0.01	0.90	6%	<0.001
Fugitive Emissions from Coal Mining	CH_4	53.8	0.01	0.91	14%	0.001
Indirect N_2O Emissions from Applied Nitrogen	N_2O	45.9	0.01	0.92	154%	0.011
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	42.3	0.01	0.92	17%	0.001
CO_2 Emissions from Cement Production	CO_2	39.4	0.01	0.93	6%	<0.001
CO_2 Emissions from Mobile Combustion: Marine	CO_2	39.0	0.01	0.94	6%	<0.001
CH_4 Emissions from Petroleum Systems	CH_4	38.6	0.01	0.94	34%	0.002
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	34.3	0.01	0.95	11%	0.001
CO_2 Emissions from Petrochemical Production	CO_2	28.1	<0.01	0.95	5%	<0.001
CO_2 Emissions from Natural Gas Systems	CO_2	25.5	<0.01	0.96	17%	0.001
CO_2 Emissions from Petroleum Systems	CO_2	22.8	<0.01	0.96	34%	0.001

CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	21.4	<0.01	0.96	9%	<0.001
N_2O Emissions from Manure Management	N_2O	18.1	<0.01	0.97	24%	0.001
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	14.9	<0.01	0.97	43%	0.001
CH_4 Emissions from Wastewater Treatment	CH_4	14.8	<0.01	0.97	27%	0.001
CH_4 Emissions from Rice Cultivation	CH_4	13.7	<0.01	0.97	64%	0.001
N_2O Emissions from Mobile Combustion: Road	N_2O	13.2	<0.01	0.97	14%	<0.001
CO_2 Emissions from Lime Production	CO_2	12.9	<0.01	0.98	2%	<0.001
CO_2 Emissions from Ammonia Production	CO_2	12.2	<0.01	0.98	7%	<0.001
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	11.0	<0.01	0.98	15%	<0.001
CO_2 Emissions from Incineration of Waste	CO_2	10.7	<0.01	0.98	26%	<0.001
N_2O Emissions from Nitric Acid Production	N_2O	10.2	<0.01	0.98	5%	<0.001
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	7.1	<0.01	0.98	215%	0.002
N_2O Emissions from Adipic Acid Production	N_2O	7.0	<0.01	0.99	5%	<0.001
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	6.7	<0.01	0.99	22%	<0.001
CO_2 Emissions from Urea Fertilization	CO_2	5.1	<0.01	0.99	43%	<0.001
N_2O Emissions from Wastewater Treatment	N_2O	5.0	<0.01	0.99	112%	0.001
PFC, HFC, SF_6, and NF_3 Emissions from Semiconductor Manufacture	Several	4.7	<0.01	0.99	6%	<0.001
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	4.5	<0.01	0.99	5%	<0.001
SF_6 Emissions from Electrical Transmission and Distribution	SF_6	4.3	<0.01	0.99	14%	<0.001
N_2O Emissions from Product Uses	N_2O	4.2	<0.01	0.99	24%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	4.0	<0.01	0.99	19%	<0.001
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	4.0	<0.01	0.99	12%	<0.001
CO_2 Emissions from Liming	CO_2	3.9	<0.01	0.99	111%	0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	3.4	<0.01	0.99	227%	0.001
N_2O Emissions from Mobile Combustion: Other	N_2O	3.2	<0.01	0.99	59%	<0.001
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	3.0	<0.01	0.99	17%	<0.001
HFC-23 Emissions from HCFC-22 Production	HFCs	2.8	<0.01	0.99	10%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	2.5	<0.01	0.99	206%	0.001
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	2.2	<0.01	1.00	15%	<0.001
CH_4 Emissions from Mobile Combustion: Other	CH_4	2.1	<0.01	1.00	50%	<0.001
CH_4 Emissions from Composting	CH_4	2.1	<0.01	1.00	50%	<0.001
N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	2.0	<0.01	1.00	31%	<0.001
N_2O Emissions from Composting	N_2O	1.9	<0.01	1.00	50%	<0.001
CO_2 Emissions from Ferroalloy Production	CO_2	1.8	<0.01	1.00	12%	<0.001
CO_2 Emissions from Soda Ash Production	CO_2	1.7	<0.01	1.00	9%	<0.001
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.6	<0.01	1.00	13%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.6	<0.01	1.00	50%	<0.001
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.5	<0.01	1.00	67%	<0.001
PFC Emissions from Aluminum Production	PFCs	1.4	<0.01	1.00	8%	<0.001
CO_2 Emissions from Aluminum Production	CO_2	1.3	<0.01	1.00	3%	<0.001
CO_2 Emissions from Glass Production	CO_2	1.2	<0.01	1.00	4%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.2	<0.01	1.00	145%	<0.001

Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	1.1	<0.01	1.00	4%	<0.001
CH_4 Emissions from Mobile Combustion: Road	CH_4	1.1	<0.01	1.00	26%	<0.001
SF_6 Emissions from Magnesium Production and Processing	SF_6	1.0	<0.01	1.00	6%	<0.001
CO_2 Emissions from Phosphoric Acid Production	CO_2	1.0	<0.01	1.00	21%	<0.001
CO_2 Emissions from Zinc Production	CO_2	0.9	<0.01	1.00	16%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	0.7	<0.01	1.00	212%	<0.001
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.5	<0.01	1.00	46%	<0.001
CO_2 Emissions from Lead Production	CO_2	0.5	<0.01	1.00	15%	<0.001
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4	<0.01	1.00	NA	<0.001
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.3	<0.01	1.00	85%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.3	<0.01	1.00	176%	<0.001
N_2O Emissions from Incineration of Waste	N_2O	0.3	<0.01	1.00	327%	<0.001
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.3	<0.01	1.00	14%	<0.001
CH_4 Emissions from Petrochemical Production	CH_4	0.2	<0.01	1.00	57%	<0.001
N_2O Emissions from Semiconductor Manufacture	N_2O	0.2	<0.01	1.00	12%	<0.001
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.2	<0.01	1.00	9%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1	<0.01	1.00	198%	<0.001
HFC-134a Emissions from Magnesium Production and Processing	HFCs	0.1	<0.01	1.00	4%	<0.001
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	<0.01	1.00	14%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	0.1	<0.01	1.00	55%	<0.001
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	+	<0.01	1.00	88%	<0.001
CH_4 Emissions from Ferroalloy Production	CH_4	+	<0.01	1.00	12%	<0.001
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+	<0.01	1.00	10%	<0.001
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+	<0.01	1.00	20%	<0.001
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+	<0.01	1.00	215%	<0.001
CO_2 Emissions from Magnesium Production and Processing	CO_2	+	<0.01	1.00	2%	<0.001
CH_4 Emissions from Incineration of Waste	CH_4	+	<0.01	1.00	NE	<0.001
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	0.0	<0.01	1.00	NE	<0.001

+ Does not exceed 0.05 MMT CO_2 Eq.
NE (Not Estimated)
NA (Not Available)
[a] Percent relative uncertainty. If the corresponding uncertainty is asymmetrical, the uncertainty given here is the larger and always positive.
Note: LULUCF sources and sinks are not included in this analysis.

Table A-7: 2016 Key Source Category Approach 1 and Approach 2 Analysis—Level Assessment with LULUCF

IPCC Source/Sink Categories	Direct Greenhouse Gas	2016 Estimate (MMT CO_2 Eq.)	Approach 1 Level Assessment	Cumulative Total	Uncertainty[a]	Approach 2 Level Assessment
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,496.0	0.20	0.20	6%	0.013
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,241.4	0.16	0.36	10%	0.016
Net CO_2 Emissions from Forest Land Remaining Forest Land	CO_2	670.5	0.09	0.45	78%	0.069

CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	546.0	0.07	0.52	5%	0.004
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	477.9	0.06	0.59	7%	0.005
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	272.5	0.04	0.62	21%	0.007
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.3	0.03	0.66	7%	0.002
Direct N_2O Emissions from Agricultural Soil Management	N_2O	237.6	0.03	0.69	16%	0.005
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	170.3	0.02	0.71	7%	0.002
CH_4 Emissions from Enteric Fermentation	CH_4	170.1	0.02	0.73	18%	0.004
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	167.4	0.02	0.76	6%	0.001
CH_4 Emissions from Natural Gas Systems	CH_4	163.5	0.02	0.78	17%	0.004
Emissions from Substitutes for Ozone Depleting Substances	Several	159.1	0.02	0.80	12%	0.002
Net CO_2 Emissions from Non-Energy Use of Fuels	CO_2	112.2	0.01	0.81	39%	0.006
CH_4 Emissions from Landfills	CH_4	107.7	0.01	0.83	23%	0.003
Net CO_2 Emissions from Settlements Remaining Settlements	CO_2	103.7	0.01	0.84	85%	0.012
CO_2 Emissions from Mobile Combustion: Other	CO_2	80.2	0.01	0.85	6%	0.001
Net CO_2 Emissions from Land Converted to Forest Land	CO_2	75.0	0.01	0.86	11%	0.001
Net CO_2 Emissions from Land Converted to Settlements	CO_2	68.0	0.01	0.87	29%	0.003
CH_4 Emissions from Manure Management	CH_4	67.7	0.01	0.88	20%	0.002
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	58.7	0.01	0.89	6%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	58.7	0.01	0.90	16%	0.001
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	54.2	0.01	0.90	6%	<0.001
Fugitive Emissions from Coal Mining	CH_4	53.8	0.01	0.91	14%	0.001
Indirect N_2O Emissions from Applied Nitrogen	N_2O	45.9	0.01	0.92	154%	0.009
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	42.3	0.01	0.92	17%	0.001
CO_2 Emissions from Cement Production	CO_2	39.4	0.01	0.93	6%	<0.001
CO_2 Emissions from Mobile Combustion: Marine	CO_2	39.0	0.01	0.93	6%	<0.001
CH_4 Emissions from Petroleum Systems	CH_4	38.6	0.01	0.94	34%	0.002
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	34.3	<0.01	0.94	11%	0.001
CO_2 Emissions from Petrochemical Production	CO_2	28.1	<0.01	0.95	5%	<0.001
CO_2 Emissions from Natural Gas Systems	CO_2	25.5	<0.01	0.95	17%	0.001
Net CO_2 Emissions from Land Converted to Cropland	CO_2	23.8	<0.01	0.95	77%	0.002
CO_2 Emissions from Petroleum Systems	CO_2	22.8	<0.01	0.95	34%	0.001
Net CO_2 Emissions from Land Converted to Grassland	CO_2	22.0	<0.01	0.96	134%	0.004
CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	21.4	<0.01	0.96	9%	<0.001
CH_4 Emissions from Forest Fires	CH_4	18.5	<0.01	0.96	127%	0.003
N_2O Emissions from Manure Management	N_2O	18.1	<0.01	0.97	24%	0.001
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	14.9	<0.01	0.97	43%	0.001
CH_4 Emissions from Wastewater Treatment	CH_4	14.8	<0.01	0.97	27%	0.001
CH_4 Emissions from Rice Cultivation	CH_4	13.7	<0.01	0.97	64%	0.001
N_2O Emissions from Mobile Combustion: Road	N_2O	13.2	<0.01	0.97	14%	<0.001
CO_2 Emissions from Lime Production	CO_2	12.9	<0.01	0.97	2%	<0.001
CO_2 Emissions from Ammonia Production	CO_2	12.2	<0.01	0.98	7%	<0.001
N_2O Emissions from Forest Fires	N_2O	12.2	<0.01	0.98	120%	0.002
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	11.0	<0.01	0.98	15%	<0.001

CO_2 Emissions from Incineration of Waste	CO_2	10.7	<0.01	0.98	26%	<0.001
N_2O Emissions from Nitric Acid Production	N_2O	10.2	<0.01	0.98	5%	<0.001
Net CO_2 Emissions from Cropland Remaining Cropland	CO_2	9.9	<0.01	0.98	452%	0.006
Net CO_2 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CO_2	7.9	<0.01	0.98	59%	0.001
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	7.1	<0.01	0.99	215%	0.002
N_2O Emissions from Adipic Acid Production	N_2O	7.0	<0.01	0.99	5%	<0.001
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	6.7	<0.01	0.99	22%	<0.001
CO_2 Emissions from Urea Fertilization	CO_2	5.1	<0.01	0.99	43%	<0.001
N_2O Emissions from Wastewater Treatment	N_2O	5.0	<0.01	0.99	112%	0.001
PFC, HFC, SF6, and NF3 Emissions from Semiconductor Manufacture	Several	4.7	<0.01	0.99	6%	<0.001
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	4.5	<0.01	0.99	5%	<0.001
SF_6 Emissions from Electrical Transmission and Distribution	SF_6	4.3	<0.01	0.99	14%	<0.001
N_2O Emissions from Product Uses	N_2O	4.2	<0.01	0.99	24%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	4.0	<0.01	0.99	19%	<0.001
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	4.0	<0.01	0.99	12%	<0.001
CO_2 Emissions from Liming	CO_2	3.9	<0.01	0.99	111%	0.001
CH_4 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CH_4	3.6	<0.01	0.99	30%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	3.4	<0.01	0.99	227%	0.001
N_2O Emissions from Mobile Combustion: Other	N_2O	3.2	<0.01	0.99	59%	<0.001
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	3.0	<0.01	0.99	17%	<0.001
HFC-23 Emissions from HCFC-22 Production	HFCs	2.8	<0.01	0.99	10%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	2.5	<0.01	0.99	206%	0.001
N_2O Emissions from Settlement Soils	N_2O	2.5	<0.01	1.00	45%	<0.001
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	2.2	<0.01	1.00	15%	<0.001
CH_4 Emissions from Mobile Combustion: Other	CH_4	2.1	<0.01	1.00	50%	<0.001
CH_4 Emissions from Composting	CH_4	2.1	<0.01	1.00	50%	<0.001
N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	2.0	<0.01	1.00	31%	<0.001
N_2O Emissions from Composting	N_2O	1.9	<0.01	1.00	50%	<0.001
CO_2 Emissions from Ferroalloy Production	CO_2	1.8	<0.01	1.00	12%	<0.001
CO_2 Emissions from Soda Ash Production	CO_2	1.7	<0.01	1.00	9%	<0.001
Net CO_2 Emissions from Grassland Remaining Grassland	CO_2	1.6	<0.01	1.00	2503%	0.005
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.6	<0.01	1.00	13%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.6	<0.01	1.00	50%	<0.001
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.5	<0.01	1.00	67%	<0.001
PFC Emissions from Aluminum Production	PFCs	1.4	<0.01	1.00	8%	<0.001
CO_2 Emissions from Aluminum Production	CO_2	1.3	<0.01	1.00	3%	<0.001
CO_2 Emissions from Glass Production	CO_2	1.2	<0.01	1.00	4%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.2	<0.01	1.00	145%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	1.1	<0.01	1.00	4%	<0.001
CH_4 Emissions from Mobile Combustion: Road	CH_4	1.1	<0.01	1.00	26%	<0.001
SF_6 Emissions from Magnesium Production and Processing	SF_6	1.0	<0.01	1.00	6%	<0.001

CO_2 Emissions from Phosphoric Acid Production	CO_2	1.0	<0.01	1.00	21%	<0.001
CO_2 Emissions from Zinc Production	CO_2	0.9	<0.01	1.00	16%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	0.7	<0.01	1.00	212%	<0.001
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.5	<0.01	1.00	46%	<0.001
CO_2 Emissions from Lead Production	CO_2	0.5	<0.01	1.00	15%	<0.001
N_2O Emissions from Forest Soils	N_2O	0.5	<0.01	1.00	318%	<0.001
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4	<0.01	1.00	NA	<0.001
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.3	<0.01	1.00	85%	<0.001
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.3	<0.01	1.00	176%	<0.001
N_2O Emissions from Grass Fires	N_2O	0.3	<0.01	1.00	144%	<0.001
N_2O Emissions from Incineration of Waste	N_2O	0.3	<0.01	1.00	327%	<0.001
CH_4 Emissions from Grass Fires	CH_4	0.3	<0.01	1.00	145%	<0.001
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.3	<0.01	1.00	14%	<0.001
CH_4 Emissions from Petrochemical Production	CH_4	0.2	<0.01	1.00	57%	<0.001
N_2O Emissions from Semiconductor Manufacture	N_2O	0.2	<0.01	1.00	12%	<0.001
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.2	<0.01	1.00	9%	<0.001
N_2O Emissions from Coastal Wetlands Remaining Coastal Wetlands	N_2O	0.1	<0.01	1.00	116%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1	<0.01	1.00	198%	<0.001
HFC-134a Emissions from Magnesium Production and Processing	HFCs	0.1	<0.01	1.00	4%	<0.001
N_2O Emissions from Drained Organic Soils	N_2O	0.1	<0.01	1.00	124%	<0.001
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	<0.01	1.00	14%	<0.001
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	0.1	<0.01	1.00	55%	<0.001
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	+	<0.01	1.00	88%	<0.001
Net CO_2 Emissions from Land Converted to Wetlands	CO_2	+	<0.01	1.00	30%	<0.001
CH_4 Emissions from Drained Organic Soils	CH_4	+	<0.01	1.00	76%	<0.001
CH_4 Emissions from Ferroalloy Production	CH_4	+	<0.01	1.00	12%	<0.001
CH_4 Emissions from Land Converted to Coastal Wetlands	CH_4	+	<0.01	1.00	30%	<0.001
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+	<0.01	1.00	10%	<0.001
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+	<0.01	1.00	20%	<0.001
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+	<0.01	1.00	215%	<0.001
CH_4 Emissions from Peatlands Remaining Peatlands	CH_4	+	<0.01	1.00	78%	<0.001
CO_2 Emissions from Magnesium Production and Processing	CO_2	+	<0.01	1.00	2%	<0.001
N_2O Emissions from Peatlands Remaining Peatlands	N_2O	+	<0.01	1.00	53%	<0.001
CH_4 Emissions from Incineration of Waste	CH_4	+	<0.01	1.00	NE	<0.001
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	0.0	<0.01	1.00	NE	<0.001

+ Does not exceed 0.05 MMT CO_2 Eq.
NE (Not Estimated)
NA (Not Available)
[a] Percent relative uncertainty. If the corresponding uncertainty is asymmetrical, the uncertainty given here is the larger and always positive.

Table A-8: 1990-2016 Key Source Category Approach 1 and 2 Analysis—Trend Assessment, without LULUCF

IPCC Source Categories	Direct Greenhouse Gas	1990 Estimate ($MMT CO_2 Eq.$)	2016 Estimate ($MMT CO_2 Eq.$)	Approach 1 Trend Assessment	Approach 2 Trend Assessment	% Contribution to Trend	Cumulative Total
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	175.3	546.0	0.06	0.003	17.4	17
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,547.6	1,241.4	0.05	0.005	16.3	34
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,162.7	1,496.0	0.05	0.003	14.5	48
Emissions from Substitutes for Ozone Depleting Substances	Several	0.3	159.1	0.02	0.003	7.5	56
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	155.3	58.7	0.02	0.002	4.8	61
CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	21.4	0.01	0.001	3.7	64
CH_4 Emissions from Landfills	CH_4	179.6	107.7	0.01	0.003	3.6	68
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	101.6	42.3	0.01	0.002	2.9	71
CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	408.9	477.9	0.01	0.001	2.8	74
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	97.4	54.2	0.01	<0.001	2.2	76
Fugitive Emissions from Coal Mining	CH_4	96.5	53.8	0.01	0.001	2.1	78
HFC-23 Emissions from HCFC-22 Production	HFCs	46.1	2.8	0.01	0.001	2.1	80
CH_4 Emissions from Natural Gas Systems	CH_4	195.2	163.5	0.01	0.001	1.7	82
CH_4 Emissions from Manure Management	CH_4	37.2	67.7	<0.01	0.001	1.4	83
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	294.7	272.5	<0.01	0.001	1.4	85
N_2O Emissions from Mobile Combustion: Road	N_2O	37.6	13.2	<0.01	0.001	1.2	86
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	142.1	170.3	<0.01	<0.001	1.2	87
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	187.4	167.4	<0.01	<0.001	1.2	88
PFC Emissions from Aluminum Production	PFCs	21.5	1.4	<0.01	<0.001	1.0	89
Direct N_2O Emissions from Agricultural Soil Management	N_2O	212.0	237.6	<0.01	0.001	1.0	90
SF_6 Emissions from Electrical Transmission and Distribution	SF_6	23.1	4.3	<0.01	<0.001	0.9	91
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	73.1	58.7	<0.01	<0.001	0.8	92
CO_2 Emissions from Petroleum Systems	CO_2	7.7	22.8	<0.01	0.001	0.7	92
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	119.5	112.2	<0.01	0.001	0.5	93
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	12.0	2.2	<0.01	<0.001	0.5	93
N_2O Emissions from Adipic Acid Production	N_2O	15.2	7.0	<0.01	<0.001	0.4	94
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	6.5	14.9	<0.01	0.001	0.4	94
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	26.9	34.3	<0.01	<0.001	0.3	95
Indirect N_2O Emissions from Applied Nitrogen	N_2O	38.5	45.9	<0.01	0.002	0.3	95
CO_2 Emissions from Mobile Combustion: Marine	CO_2	44.3	39.0	<0.01	<0.001	0.3	95
CO_2 Emissions from Petrochemical Production	CO_2	21.2	28.1	<0.01	<0.001	0.3	95
CO_2 Emissions from Aluminum Production	CO_2	6.8	1.3	<0.01	<0.001	0.3	96
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.0	238.3	<0.01	<0.001	0.3	96
CO_2 Emissions from Mobile Combustion: Other	CO_2	73.2	80.2	<0.01	<0.001	0.2	96
CO_2 Emissions from Cement Production	CO_2	33.5	39.4	<0.01	<0.001	0.2	96
CO_2 Emissions from Natural Gas Systems	CO_2	29.8	25.5	<0.01	<0.001	0.2	97

CH_4 Emissions from Mobile Combustion: Other	CH_4	7.0	2.1	<0.01	<0.001	0.2	97
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	6.3	11.0	<0.01	<0.001	0.2	97
SF_6 Emissions from Magnesium Production and Processing	SF_6	5.2	1.0	<0.01	<0.001	0.2	97
CH_4 Emissions from Mobile Combustion: Road	CH_4	5.2	1.1	<0.01	<0.001	0.2	98
N_2O Emissions from Manure Management	N_2O	14.0	18.1	<0.01	<0.001	0.2	98
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	0.6	4.0	<0.01	<0.001	0.2	98
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	3.0	0.0	<0.01	<0.001	0.1	98
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	0.0	3.0	<0.01	<0.001	0.1	98
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	1.5	4.5	<0.01	<0.001	0.1	98
CH_4 Emissions from Rice Cultivation	CH_4	16.0	13.7	<0.01	<0.001	0.1	98
CO_2 Emissions from Urea Fertilization	CO_2	2.4	5.1	<0.01	<0.001	0.1	99
CO_2 Emissions from Incineration of Waste	CO_2	8.0	10.7	<0.01	<0.001	0.1	99
N_2O Emissions from Nitric Acid Production	N_2O	12.1	10.2	<0.01	<0.001	0.1	99
CH_4 Emissions from Petroleum Systems	CH_4	39.8	38.6	<0.01	<0.001	0.1	99
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	5.2	3.4	<0.01	0.001	0.1	99
CH_4 Emissions from Enteric Fermentation	CH_4	164.2	170.1	<0.01	<0.001	0.1	99
CH_4 Emissions from Composting	CH_4	0.4	2.1	<0.01	<0.001	0.1	99
N_2O Emissions from Composting	N_2O	0.3	1.9	<0.01	<0.001	0.1	99
N_2O Emissions from Wastewater Treatment	N_2O	3.4	5.0	<0.01	<0.001	0.1	99
N_2O Emissions from Mobile Combustion: Other	N_2O	1.8	3.2	<0.01	<0.001	0.1	99
CH_4 Emissions from Wastewater Treatment	CH_4	15.7	14.8	<0.01	<0.001	0.1	99
CO_2 Emissions from Ammonia Production	CO_2	13.0	12.2	<0.01	<0.001	0.1	100
PFC, HFC, SF_6, and NF_3 Emissions from Semiconductor Manufacture	Several	3.6	4.7	<0.01	<0.001	0.1	100
CO_2 Emissions from Lime Production	CO_2	11.7	12.9	<0.01	<0.001	<0.1	100
CO_2 Emissions from Liming	CO_2	4.7	3.9	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	0.4	1.1	<0.01	<0.001	<0.1	100
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	7.2	6.7	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	3.1	2.5	<0.01	<0.001	<0.1	100
CO_2 Emissions from Phosphoric Acid Production	CO_2	1.5	1.0	<0.01	<0.001	<0.1	100
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	6.5	7.1	<0.01	<0.001	<0.1	100
CO_2 Emissions from Ferroalloy Production	CO_2	2.2	1.8	<0.01	<0.001	<0.1	100
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.2	1.6	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	1.0	0.7	<0.01	<0.001	<0.1	100
CO_2 Emissions from Glass Production	CO_2	1.5	1.2	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.8	1.6	<0.01	<0.001	<0.1	100
N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.7	2.0	<0.01	<0.001	<0.1	100
CO_2 Emissions from Zinc Production	CO_2	0.6	0.9	<0.01	<0.001	<0.1	100
CO_2 Emissions from Soda Ash Production	CO_2	1.4	1.7	<0.01	<0.001	<0.1	100
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.7	1.5	<0.01	<0.001	<0.1	100
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.4	0.2	<0.01	<0.001	<0.1	100

N_2O Emissions from Semiconductor Manufacture	N_2O	+	0.2	<0.01	<0.001	<0.1	100
N_2O Emissions from Incineration of Waste	N_2O	0.5	0.3	<0.01	<0.001	<0.1	100
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.5	0.3	<0.01	<0.001	<0.1	100
N_2O Emissions from Product Uses	N_2O	4.2	4.2	<0.01	<0.001	<0.1	100
HFC-134a Emissions from Magnesium Production and Processing	HFCs	0.0	0.1	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.1	1.2	<0.01	<0.001	<0.1	100
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	3.8	4.0	<0.01	<0.001	<0.1	100
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.6	0.5	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.4	0.3	<0.01	<0.001	<0.1	100
CO_2 Emissions from Lead Production	CO_2	0.5	0.5	<0.01	<0.001	<0.1	100
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.2	0.3	<0.01	<0.001	<0.1	100
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	0.1	+	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1	0.1	<0.01	<0.001	<0.1	100
CH_4 Emissions from Petrochemical Production	CH_4	0.2	0.2	<0.01	<0.001	<0.1	100
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+	+	<0.01	<0.001	<0.1	100
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+	+	<0.01	<0.001	<0.1	100
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	0.1	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	+	0.1	<0.01	<0.001	<0.1	100
CH_4 Emissions from Ferroalloy Production	CH_4	+	+	<0.01	<0.001	<0.1	100
CO_2 Emissions from Magnesium Production and Processing	CO_2	+	+	<0.01	<0.001	<0.1	100
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+	+	<0.01	<0.001	<0.1	100
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4	0.4	<0.01	<0.001	<0.1	100
CH_4 Emissions from Incineration of Waste	CH_4	+	+	<0.01	<0.001	<0.1	100

+ Does not exceed 0.05 MMT CO_2 Eq.
Note: LULUCF sources and sinks are not included in this analysis.

Table A-9: 1990-2016 Key Source Category Approach 1 and 2 Analysis—Trend Assessment, with LULUCF

IPCC Source Categories	Direct Greenhouse Gas	1990 Estimate (MMT CO_2 Eq.)	2016 Estimate (MMT CO_2 Eq.)	Approach 1 Trend Assessment	Approach 2 Trend Assessment	% Contribution to Trend	Cumulative Total
CO_2 Emissions from Stationary Combustion - Gas - Electricity Generation	CO_2	175.3	546.0	0.05	0.003	16.0	16
CO_2 Emissions from Stationary Combustion - Coal - Electricity Generation	CO_2	1,547.6	1,241.4	0.05	0.004	14.6	31
CO_2 Emissions from Mobile Combustion: Road	CO_2	1,162.7	1,496.0	0.04	0.003	13.6	44
Emissions from Substitutes for Ozone Depleting Substances	Several	0.3	159.1	0.02	0.003	6.9	51
CO_2 Emissions from Stationary Combustion - Coal - Industrial	CO_2	155.3	58.7	0.01	0.002	4.3	56
CO_2 Emissions from Stationary Combustion - Oil - Electricity Generation	CO_2	97.5	21.4	0.01	0.001	3.4	59
CH_4 Emissions from Landfills	CH_4	179.6	107.7	0.01	0.002	3.3	62

CO_2 Emissions from Stationary Combustion - Gas - Industrial	CO_2	408.9	477.9	0.01	0.001	2.7	65
CO_2 Emissions from Iron and Steel Production & Metallurgical Coke Production	CO_2	101.6	42.3	0.01	0.001	2.7	68
CO_2 Emissions from Stationary Combustion - Oil - Residential	CO_2	97.4	54.2	0.01	<0.001	2.0	70
Fugitive Emissions from Coal Mining	CH_4	96.5	53.8	0.01	0.001	1.9	72
HFC-23 Emissions from HCFC-22 Production	HFCs	46.1	2.8	0.01	0.001	1.9	73
Net CO_2 Emissions from Forest Land Remaining Forest Land	CO_2	697.7	670.5	0.01	0.004	1.8	75
CH_4 Emissions from Natural Gas Systems	CH_4	195.2	163.5	<0.01	0.001	1.5	77
Net CO_2 Emissions from Cropland Remaining Cropland	CO_2	40.9	9.9	<0.01	0.019	1.4	78
Net CO_2 Emissions from Land Converted to Settlements	CO_2	37.2	68.0	<0.01	0.001	1.3	79
CH_4 Emissions from Manure Management	CH_4	37.2	67.7	<0.01	0.001	1.3	81
CO_2 Emissions from Stationary Combustion - Oil - Industrial	CO_2	294.7	272.5	<0.01	0.001	1.2	82
CO_2 Emissions from Stationary Combustion - Gas - Commercial	CO_2	142.1	170.3	<0.01	<0.001	1.1	83
N_2O Emissions from Mobile Combustion: Road	N_2O	37.6	13.2	<0.01	<0.001	1.1	84
CO_2 Emissions from Mobile Combustion: Aviation	CO_2	187.4	167.4	<0.01	<0.001	1.0	85
Direct N_2O Emissions from Agricultural Soil Management	N_2O	212.0	237.6	<0.01	<0.001	0.9	86
PFC Emissions from Aluminum Production	PFCs	21.5	1.4	<0.01	<0.001	0.9	87
Net CO_2 Emissions from Land Converted to Cropland	CO_2	43.3	23.8	<0.01	0.002	0.9	88
SF_6 Emissions from Electrical Transmission and Distribution	SF_6	23.1	4.3	<0.01	<0.001	0.8	89
Net CO_2 Emissions from Land Converted to Forest Land	CO_2	92.0	75.0	<0.01	<0.001	0.8	90
Net CO_2 Emissions from Settlements Remaining Settlements	CO_2	86.2	103.7	<0.01	0.002	0.7	90
CO_2 Emissions from Stationary Combustion - Oil - Commercial	CO_2	73.1	58.7	<0.01	<0.001	0.7	91
CH_4 Emissions from Forest Fires	CH_4	3.2	18.5	<0.01	0.003	0.7	92
CO_2 Emissions from Petroleum Systems	CO_2	7.7	22.8	<0.01	0.001	0.7	92
N_2O Emissions from Forest Fires	N_2O	2.1	12.2	<0.01	0.002	0.4	93
CO_2 Emissions from Stationary Combustion - Coal - Commercial	CO_2	12.0	2.2	<0.01	<0.001	0.4	93
CO_2 Emissions from Non-Energy Use of Fuels	CO_2	119.5	112.2	<0.01	0.001	0.4	94
N_2O Emissions from Adipic Acid Production	N_2O	15.2	7.0	<0.01	<0.001	0.4	94
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	N_2O	6.5	14.9	<0.01	<0.001	0.4	94
CO_2 Emissions from Stationary Combustion - Oil - U.S. Territories	CO_2	26.9	34.3	<0.01	<0.001	0.3	95
Indirect N_2O Emissions from Applied Nitrogen	N_2O	38.5	45.9	<0.01	0.001	0.3	95
CO_2 Emissions from Petrochemical Production	CO_2	21.2	28.1	<0.01	<0.001	0.3	95
CO_2 Emissions from Mobile Combustion: Marine	CO_2	44.3	39.0	<0.01	<0.001	0.3	95
CO_2 Emissions from Aluminum Production	CO_2	6.8	1.3	<0.01	<0.001	0.2	96
CO_2 Emissions from Mobile Combustion: Other	CO_2	73.2	80.2	<0.01	<0.001	0.2	96
CO_2 Emissions from Cement Production	CO_2	33.5	39.4	<0.01	<0.001	0.2	96

CH_4 Emissions from Mobile Combustion: Other	CH_4	7.0	2.1	<0.01	<0.001	0.2	96
CO_2 Emissions from Natural Gas Systems	CO_2	29.8	25.5	<0.01	<0.001	0.2	97
CO_2 Emissions from Other Process Uses of Carbonates	CO_2	6.3	11.0	<0.01	<0.001	0.2	97
SF_6 Emissions from Magnesium Production and Processing	SF_6	5.2	1.0	<0.01	<0.001	0.2	97
CH_4 Emissions from Mobile Combustion: Road	CH_4	5.2	1.1	<0.01	<0.001	0.2	97
CO_2 Emissions from Stationary Combustion - Gas - Residential	CO_2	238.0	238.3	<0.01	<0.001	0.2	97
N_2O Emissions from Manure Management	N_2O	14.0	18.1	<0.01	<0.001	0.2	98
Net CO_2 Emissions from Land Converted to Grassland	CO_2	17.9	22.0	<0.01	0.001	0.2	98
CO_2 Emissions from Stationary Combustion - Coal - U.S. Territories	CO_2	0.6	4.0	<0.01	<0.001	0.1	98
CO_2 Emissions from Stationary Combustion - Coal - Residential	CO_2	3.0	0.0	<0.01	<0.001	0.1	98
CO_2 Emissions from Stationary Combustion - Gas - U.S. Territories	CO_2	0.0	3.0	<0.01	<0.001	0.1	98
CO_2 Emissions from Carbon Dioxide Consumption	CO_2	1.5	4.5	<0.01	<0.001	0.1	98
CH_4 Emissions from Enteric Fermentation	CH_4	164.2	170.1	<0.01	<0.001	0.1	98
Net CO_2 Emissions from Grassland Remaining Grassland	CO_2	4.2	1.6	<0.01	0.009	0.1	98
CO_2 Emissions from Urea Fertilization	CO_2	2.4	5.1	<0.01	<0.001	0.1	99
CH_4 Emissions from Rice Cultivation	CH_4	16.0	13.7	<0.01	<0.001	0.1	99
CO_2 Emissions from Incineration of Waste	CO_2	8.0	10.7	<0.01	<0.001	0.1	99
N_2O Emissions from Nitric Acid Production	N_2O	12.1	10.2	<0.01	<0.001	0.1	99
Non-CO_2 Emissions from Stationary Combustion - Residential	CH_4	5.2	3.4	<0.01	0.001	0.1	99
CH_4 Emissions from Petroleum Systems	CH_4	39.8	38.6	<0.01	<0.001	0.1	99
CH_4 Emissions from Composting	CH_4	0.4	2.1	<0.01	<0.001	0.1	99
N_2O Emissions from Composting	N_2O	0.3	1.9	<0.01	<0.001	0.1	99
N_2O Emissions from Wastewater Treatment	N_2O	3.4	5.0	<0.01	<0.001	0.1	99
N_2O Emissions from Mobile Combustion: Other	N_2O	1.8	3.2	<0.01	<0.001	0.1	99
CH_4 Emissions from Wastewater Treatment	CH_4	15.7	14.8	<0.01	<0.001	0.1	99
PFC, HFC, SF_6, and NF_3 Emissions from Semiconductor Manufacture	Several	3.6	4.7	<0.01	<0.001	<0.1	99
CO_2 Emissions from Ammonia Production	CO_2	13.0	12.2	<0.01	<0.001	<0.1	100
N_2O Emissions from Settlement Soils	N_2O	1.4	2.5	<0.01	<0.001	<0.1	100
CO_2 Emissions from Lime Production	CO_2	11.7	12.9	<0.01	<0.001	<0.1	100
CO_2 Emissions from Liming	CO_2	4.7	3.9	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Electricity Generation	CH_4	0.4	1.1	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Industrial	N_2O	3.1	2.5	<0.01	<0.001	<0.1	100
Fugitive Emissions from Abandoned Underground Coal Mines	CH_4	7.2	6.7	<0.01	<0.001	<0.1	100
CO_2 Emissions from Phosphoric Acid Production	CO_2	1.5	1.0	<0.01	<0.001	<0.1	100
CH_4 Emissions from Abandoned Oil and Gas Wells	CH_4	6.5	7.1	<0.01	<0.001	<0.1	100
CO_2 Emissions from Ferroalloy Production	CO_2	2.2	1.8	<0.01	<0.001	<0.1	100
CO_2 Emissions from Titanium Dioxide Production	CO_2	1.2	1.6	<0.01	<0.001	<0.1	100
N_2O Emissions from Forest Soils	N_2O	0.1	0.5	<0.01	<0.001	<0.1	100

Non-CO_2 Emissions from Stationary Combustion - Residential	N_2O	1.0	0.7	<0.01	<0.001	<0.1	100
CO_2 Emissions from Glass Production	CO_2	1.5	1.2	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Industrial	CH_4	1.8	1.6	<0.01	<0.001	<0.1	100
N_2O Emissions from Caprolactam, Glyoxal, and Glyoxylic Acid Production	N_2O	1.7	2.0	<0.01	<0.001	<0.1	100
CO_2 Emissions from Zinc Production	CO_2	0.6	0.9	<0.01	<0.001	<0.1	100
CO_2 Emissions from Soda Ash Production	CO_2	1.4	1.7	<0.01	<0.001	<0.1	100
N_2O Emissions from Mobile Combustion: Aviation	N_2O	1.7	1.5	<0.01	<0.001	<0.1	100
N_2O Emissions from Grass Fires	N_2O	0.1	0.3	<0.01	<0.001	<0.1	100
CH_4 Emissions from Grass Fires	CH_4	0.1	0.3	<0.01	<0.001	<0.1	100
CO_2 Emissions from Silicon Carbide Production and Consumption	CO_2	0.4	0.2	<0.01	<0.001	<0.1	100
N_2O Emissions from Semiconductor Manufacture	N_2O	+	0.2	<0.01	<0.001	<0.1	100
Net CO_2 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CO_2	7.6	7.9	<0.01	<0.001	<0.1	100
N_2O Emissions from Incineration of Waste	N_2O	0.5	0.3	<0.01	<0.001	<0.1	100
CH_4 Emissions from Mobile Combustion: Marine	CH_4	0.5	0.3	<0.01	<0.001	<0.1	100
CO_2 Emissions from Urea Consumption for Non-Ag Purposes	CO_2	3.8	4.0	<0.01	<0.001	<0.1	100
HFC-134a Emissions from Magnesium Production and Processing	HFCs	0.0	0.1	<0.01	<0.001	<0.1	100
N_2O Emissions from Product Uses	N_2O	4.2	4.2	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Commercial	CH_4	1.1	1.2	<0.01	<0.001	<0.1	100
CH_4 Emissions from Coastal Wetlands Remaining Coastal Wetlands	CH_4	3.4	3.6	<0.01	<0.001	<0.1	100
N_2O Emissions from Mobile Combustion: Marine	N_2O	0.6	0.5	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - Commercial	N_2O	0.4	0.3	<0.01	<0.001	<0.1	100
CO_2 Emissions from Lead Production	CO_2	0.5	0.5	<0.01	<0.001	<0.1	100
CH_4 Emissions from Field Burning of Agricultural Residues	CH_4	0.2	0.3	<0.01	<0.001	<0.1	100
CH_4 Emissions from Mobile Combustion: Aviation	CH_4	0.1	+	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	N_2O	0.1	0.1	<0.01	<0.001	<0.1	100
CH_4 Emissions from Petrochemical Production	CH_4	0.2	0.2	<0.01	<0.001	<0.1	100
CH_4 Emissions from Silicon Carbide Production and Consumption	CH_4	+	+	<0.01	<0.001	<0.1	100
CH_4 Emissions from Iron and Steel Production & Metallurgical Coke Production	CH_4	+	+	<0.01	<0.001	<0.1	100
N_2O Emissions from Field Burning of Agricultural Residues	N_2O	0.1	0.1	<0.01	<0.001	<0.1	100
Non-CO_2 Emissions from Stationary Combustion - U.S. Territories	CH_4	+	0.1	<0.01	<0.001	<0.1	100
N_2O Emissions from Coastal Wetlands Remaining Coastal Wetlands	N_2O	0.1	0.1	<0.01	<0.001	<0.1	100
Net CO_2 Emissions from Land Converted to Wetlands	CO_2	+	+	<0.01	<0.001	<0.1	100
CH_4 Emissions from Ferroalloy Production	CH_4	+	+	<0.01	<0.001	<0.1	100
CO_2 Emissions from Stationary Combustion - Geothermal Energy	CO_2	0.4	0.4	<0.01	<0.001	<0.1	100

CH_4 Emissions from Land Converted to Coastal Wetlands	CH_4	+	+	<0.01	<0.001	<0.1	100
N_2O Emissions from Drained Organic Soils	N_2O	0.1	0.1	<0.01	<0.001	<0.1	100
CH_4 Emissions from Peatlands Remaining Peatlands	CH_4	+	+	<0.01	<0.001	<0.1	100
CO_2 Emissions from Magnesium Production and Processing	CO_2	+	+	<0.01	<0.001	<0.1	100
CO_2 Emissions from Abandoned Oil and Gas Wells	CO_2	+	+	<0.01	<0.001	<0.1	100
CH_4 Emissions from Drained Organic Soils	CH_4	+	+	<0.01	<0.001	<0.1	100
N_2O Emissions from Peatlands Remaining Peatlands	N_2O	+	+	<0.01	<0.001	<0.1	100
CH_4 Emissions from Incineration of Waste	CH_4	+	+	<0.01	<0.001	<0.1	100

+ Does not exceed 0.05 MMT CO_2 Eq.

References

IPCC (2006) *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.