ANNEX 2

MAPPING TABLES

Contents

Annex 2 Relating 2019 Refinement to the 2006 IPCC Guidelines

This annex provides a road map for relating sections, equations, tables, figures and boxes in the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.*

Type of Refinement: U – Update, NG – New Guidance, NR – No Refinement, R – Removed

CHAPTER 1 INTRODUCTION

Only Figure 1 in Section 1.2 was updated due to the refinement in Chapter 4. Equations, tables and boxes were not updated.

Sections

- Only Figure 1.1 was updated.

Section Title	Type of Refinement	2006 IPCC Guidelines Section Number	2019 Refinement Section Number
Source categories	U	1.2	1.2

Figures

- Composition of 1.B.1.a, 1.B.1.c and 1.B.2 in Figure 1.1 was revised due to the refinement in Chapter 4.

Figure Title	Type of Refinement	2006 IPCC Guidelines Figure Number	2019 Refinement Figure Number
Activity and source structure in the Energy Sector	U	1.1	1.1

CHAPTER 2 STATIONARY COMBUSTION

Updates were made to provide clarification on treatment of biomass. Only main text in Section 2.3.3.4 was updated, and equations, tables, figures and boxes were not updated.

Sections

- Section 2.3.3.4 was updated to provide additional clarification on the treatment of biomass, consistent with Volume 1, Chapter 1, and also to provide a bullet noting the location in the AFOLU volume of clarification of the reporting of emissions from woody biomass combustion for energy.

Section Title	Type of Refinement	2006 IPCC Guidelines Section Number	2019 Refinement Section Number
Treatment of biomass	U	2.3.3.4	2.3.3.4

CHAPTER 4 FUGITIVE EMISSIONS

For fugitive emissions from mining, processing, storage and transportation of coal, the *2019 Refinement* includes guidance on emissions of carbon dioxide (CO_2) emissions from underground and surface mines.

For fugitive emissions from oil and natural gas systems, the *2019 Refinement* includes emission factors representative of current practice, including for unconventional oil and gas exploration, and methods and emission factors for abandoned wells.

For fuel transformation, the *2019 Refinement* includes a new section on fugitive emissions from fuel transformation, including methods for fugitive emissions from charcoal production, coke production, coal to liquids and gas to liquids.

Sections

- Section 4.1.1: Updated to include description of new coal exploration source.
- Section 4.1.2: Updated to add that methodological issues also includes carbon dioxide emissions from underground and surface mining, and to add general guidance for estimating fugitive emissions from coal exploration.
- Section 4.1.3: Updated to add method for estimating carbon dioxide emissions from underground mines, and to add uncertainty estimates for underground mining carbon dioxide emission factors.
- Section 4.1.4: Updated to add method for estimating carbon dioxide emissions from surface mines, and to add uncertainty estimates for surface mining carbon dioxide emission factors.
- Section 4.1.5: Updated to extend time boundary of Tier 1 approach.
- Section 4.1.6: Minor updates to provide consistency with added method for estimating carbon dioxide emissions from underground and surface mines.
- Section 4.2: Updated to reflect inclusion of town gas, biogas, and abandoned wells, provide clarification on coalbed methane and on system boundary (i.e. includes leaks from appliances).
- Section 4.2.1: Updated to reflect updated practices, including two updated figures.
- Section 4.2.2: Minor updates to clarify that fugitive includes venting, flaring, and leaks.
- Section 4.2.2.1: Minor updates to improve consistency between sections.
- Section 4.2.2.2: Updated to provide background on technology and practice-specific factors.
- Section 4.2.2.3: Updated to reflect the latest data, including information on updated practices, including abandoned wells, and more detailed descriptions of each segment.
- Section 4.2.2.4: Updated to move sentence on production statistics to this section, and updated tables to reflect revisions to factors and new subcategories.
- Section 4.2.2.5: Updated to remove reference to previous completeness table, which was inconsistent with both *2006 IPCC Guidelines* and the *2019 Refinements*.
- Section 4.2.2.6 - 4.2.2.7: Updated to reflect changing practices and technologies over time.
- Section 4.2.3: Updated to reflect the latest information.
- Section 4.2.4: Updated to reflect changing practices and technologies over time, and updated disaggregation by segment.
- Section 4.3: Newly included section on fugitive emissions from fuel transformation, including methods for fugitive emissions from charcoal production, coke production, coal to liquids and gas to liquids.
- Annexes 4A.1 - 4A.3: Newly provided to add information for oil and gas systems.
- Appendix 4A.1: Added to reflect some possibilities for future methodological development related to abandoned surface mines and coal exploration.
- Appendix 4A.2 – 4A.3: Added to reflect some possibilities for future methodological development related to fuel transformation.

Section Title	Type of Refinement	2006 IPCC Guidelines Section Number	2019 Refinement Section Number
Fugitive emissions from mining, processing, storage and transportation of coal	U	4.1	4.1
Overview and description of sources	U	4.1.1	4.1.1
Coal mining and handling	U	4.1.1.1	4.1.1.1
Summary of sources	U	4.1.1.2	4.1.1.2
Methodological issues	U	4.1.2	4.1.2
Underground coal mines	U	4.1.3	4.1.3
Choice of method	U	4.1.3.1	4.1.3.1
Choice of emission factors for underground mines	U	4.1.3.2	4.1.3.2
Choice of activity data	NR	4.1.3.3	4.1.3.3
Completeness for underground coal mines	NR	4.1.3.4	4.1.3.4
Developing a consistent time series	NR	4.1.3.5	4.1.3.5
Uncertainty assessment	U	4.1.3.6	4.1.3.6
Surface coal mining	U	4.1.4	4.1.4
Choice of method	U	4.1.4.1	4.1.4.1
Emission factors for surface mining	U	4.1.4.2	4.1.4.2
Activity data	NR	4.1.4.3	4.1.4.3
Completeness for surface mining	NR	4.1.4.4	4.1.4.4
Developing a consistent time series	NR	4.1.4.5	4.1.4.5
Uncertainty Assessment in emissions	U	4.1.4.6	4.1.4.6
Abandoned underground coal mines	U	4.1.5	4.1.5
Choice of method	NR	4.1.5.1	4.1.5.1
Choice of emission factors	U	4.1.5.2	4.1.5.2
Choice of activity data	NR	4.1.5.3	4.1.5.3
Completeness	NR	4.1.5.4	4.1.5.4
Developing a consistent time series	NR	4.1.5.5	4.1.5.5
Uncertainty assessment	NR	4.1.5.6	4.1.5.6
Completeness for coal mining	U	4.1.6	4.1.6
Inventory Quality Assurance/Quality Control (QA/QC)	NR	4.1.7	4.1.7
Fugitive Emissions from Oil and Natural Gas Systems	U	4.2	4.2
Overview and description of sources	U	4.2.1	4.2.1
Methodological issues	U	4.2.2	4.2.2
Choice of method, decision trees, tiers	U	4.2.2.1	4.2.2.1
Choice of method	U	4.2.2.2	4.2.2.2
Choice of emission factor	U	4.2.2.3	4.2.2.3
Choice of activity data	U	4.2.2.4	4.2.2.4
Completeness	U	4.2.2.5	4.2.2.5
Developing consistent time series	U	4.2.2.6	4.2.2.6
Uncertainty assessment	U	4.2.2.7	4.2.2.7

Section Title	Type of Refinement	2006 IPCC Guidelines Section Number	2019 Refinement Section Number
Inventory Quality Assurance/Quality Control (QA/QC)	U	4.2.3	4.2.3
Reporting and Documentation	U	4.2.4	4.2.4
Fugitive Emissions from Fuel Transformation	NG	–	4.3
Standard Conditions	NG	–	Annex 4.1
Disaggregation of Tier 1 factors presented in Section 4.2.2.3	NG	–	Annex 4.2
Definition of terminologies used in Section 4.2	NG	–	Annex 4.3
Fugitive emissions from mining, processing, storage and transportation of coal: Basis for Future Methodological Development	NG	–	Appendix 4.1
Abandoned Surface Mines	NG	–	Appendix 4.1.1
Coal Exploration	NG	--	Appendix 4.1.2
Fugitive Greenhouse Gas Emissions from Wood Pellet production: Basis for Future Methodological Development	NG	–	Appendix 4.2
Fugitive Emissions from Biomass to Liquid and Biomass to Gas: Basis for Future Methodological Development	NG	–	Appendix 4.3
References	U	–	–

Equations

- Equation 4.1.0: Example equation for estimating fugitive emissions from coal exploration was newly provided.
- Equations 4.1.2 - 4.1.3: Equations for CH_4 emissions were updated and the equation for CO_2 was newly provided for underground mine.
- Equations 4.1.6 - 4.1.7: Equations for CH_4 emissions were updated and the equation for CO_2 was newly provided for surface mine.
- Equations 4.2.9 - 4.2.18: General equation for emissions from each segment was newly provided for oil and natural gas systems.
- Equations 4.3.1 - 4.3.5: Equations for emissions from fuel transformation were newly provided.
- Equations in Annexes and Appendixes: Newly provided.

Equation Title	Type of Refinement	2006 IPCC Guidelines Equation Number	2019 Refinement Equation Number
Example equation for estimating fugitive emissions from coal exploration	NG	–	4.1.0
Estimating emissions from underground coal mines for Tier 1 and Tier 2 without adjustment for methane utilisation or flaring	NR	4.1.1	4.1.1
Estimating emissions from underground coal mines for Tier 1 and Tier 2 with adjustment for methane utilisation or flaring	U	4.1.2	4.1.2
Tier 1: global average method – underground mining – methane – before adjustment for any methane utilisation or flaring	U	4.1.3	4.1.3
Tier 1: global average method – underground mining – carbon dioxide	NG	–	4.1.3a
Tier 1: global average method – post-mining emissions – underground mines	NR	4.1.4	4.1.4
Emissions of CO_2 and CH_4 from drained methane flared or catalytically oxidised	NR	4.1.5	4.1.5
General equation for estimating fugitive emissions from surface coal mining	U	4.1.6	4.1.6
Tier 1: global average method – surface mines – methane	U	4.1.7	4.1.7
Tier 1: global average method – surface mines– carbon dioxide	NG	–	4.1.7a
Tier 1: global average method – post-mining emissions – surface mines	NR	4.1.8	4.1.8
General equation for estimating fugitive emissions from abandoned underground coal mines	NR	4.1.9	4.1.9

Equation Title	Type of Refinement	2006 IPCC Guidelines Equation Number	2019 Refinement Equation Number
Tier 1 approach for abandoned underground mines	NR	4.1.10	4.1.10
Tier 2 approach for abandoned underground mines without methane recovery and utilization	NR	4.1.11	4.1.11
Tier 2 – abandoned underground coal mines emission factor	NR	4.1.12	4.1.12
Example of Tier 3 emissions calculation – abandoned underground mines	NR	4.1.13	4.1.13
Tier 1: estimating fugitive emissions from an industry segment	NR	4.2.1	4.2.1
Tier 1: total fugitive emissions from industry segments	NR	4.2.2	4.2.2
Alternative Tier 2 approach (emissions due to venting)	NR	4.2.3	4.2.3
Alternative Tier 2 approach (CH_4 emissions due to flaring)	NR	4.2.4	4.2.4
Alternative Tier 2 approach (CO_2 emissions due to flaring)	NR	4.2.5	4.2.5
CH_4 emissions from flaring and venting	NR	4.2.6	4.2.6
CO_2 emissions from venting and flaring	NR	4.2.7	4.2.7
N_2O emissions from flaring	NR	4.2.8	4.2.8
General equation for estimating fugitive emissions from Exploration	NG	–	4.2.9
General equation for estimating fugitive emissions from Oil Production and Upgrading	NG	–	4.2.10
General equation for estimating fugitive emissions from Oil Transportation	NG	–	4.2.11
General equation for estimating fugitive emissions from Distribution of Oil Products	NG	–	4.2.12
General equation for estimating fugitive emissions from Exploration	NG	–	4.2.13
General equation for estimating fugitive emissions from Gas Production and Gathering	NG	–	4.2.14
General equation for estimating fugitive emissions from Gas Processing	NG	–	4.2.15
General equation for estimating fugitive emissions from Gas Transmission and Storage	NG	–	4.2.16
General equation for estimating fugitive emissions from Gas Distribution	NG	–	4.2.17
General equation for estimating fugitive emissions from Post-meter Leakage	NG	–	4.2.18
Fugitive GHG emissions from charcoal (or Biochar) production on annual basis	NG	–	4.3.1
Fugitive GHG emissions from coke production	NG	–	4.3.2
Fugitive CO_2 emissions from the Flaring of Coke Oven Gas	NG	–	4.3.3
Fugitive CH_4 and N_2O emissions from the Flaring of Coke Oven Gas	NG	–	4.3.4
Fugitive GHG emissions from gasification processes	NG	–	4.3.5

Equation Title	Type of Refinement	2006 IPCC Guidelines Equation Number	2019 Refinement Equation Number
Conversion of oil density at 15°C	NG	–	4A.1.1
Conversion of relative oil density at 15.556°C (60°F)	NG	–	4A.1.2
Conversion of API density	NG	–	4A.1.3
Conversion of gas volume	NG	–	4A.1.4
Tier 1: Global Average Method—Fugitive Emission from Coal Exploration Boreholes	NG	--	4Ap.1.1
Tier 2: Basin-Specific Method	NG	--	4Ap.1.2
Fugitive GHG emissions from gasification processes	NG	-	4Ap.3.1

Tables

- Table 4.1.1: “Abandoned surface mines” and “Coal exploration” were added to the list of detailed sectors.
- Tables 4.1.2 and 4.1.4: The uncertainties of coal mine carbon dioxide emission factors were added to those of methane.
- Table 4.1.6: Emission factors for future emissions were added.
- Table 4.1.7: Wording corrected.
- Table 4.2.1: Removed. Information included here is now available in Table 4.2.2. and Figure 4.2.0.
- Table 4.2.2: Updated to include unconventional exploration, abandoned wells, and post-meter, and to improve clarity.
- Tables 4.2.4 – 4.2.4k: Former Tables 4.2.4 and 4.2.5 were re-organized and divided to the tables by segment.
- Table 4.2.5: Emission factors were incorporated to Tables 4.2.4 – 4.2.4k and Table 4.2.5 was removed.
- Table 4.2.6: Updated to include information on abandoned wells
- Table 4.2.7: Updated to include information on abandoned wells and on activity for the updated emission factors.
- Table 4.2.8: Removed. This table is no longer relevant with the updated emission factors.
- Table 4.2.9: Updated according to refined sub-categories and segments.
- Tables 4.3.1 – 4.3.12: Default emission factors, uncertainty and other information were newly provided for Fuel Transformation.
- Tables in Annexes: Newly provided.
- Table in Appendix: Newly provided.

Table Title	Type of Refinement	2006 IPCC Guidelines Table Number	2019 Refinement Table Number
Detailed sector split for emissions from mining, processing, storage and transport of coal	U	4.1.1	4.1.1
Estimates of uncertainty for underground mining for Tier 1 and Tier 2 approaches	U	4.1.2	4.1.2
Estimates of uncertainty for underground coal mining for a Tier 3 approach	NR	4.1.3	4.1.3
Estimates of uncertainty for surface mining for Tier 1 and Tier 2 approaches	U	4.1.4	4.1.4
Tier 1 – abandoned underground mines - default values - percentage of coal mines that are gassy	NR	4.1.5	4.1.5
Tier 1 – abandoned underground mines - emission factor, million m3 methane / mine	U	4.1.6	4.1.6
Tier 1 – abandoned underground mines Example Calculation	U	4.1.7	4.1.7
Tier 2 – abandoned underground coal mines - default values for active mine emissions prior to abandonment	NR	4.1.8	4.1.8
Coefficients for Tier 2 – abandoned underground coal mines	NR	4.1.9	4.1.9
Detailed sector split for emissions from production and transport of oil and natural gas	R	4.2.1	–
Major categories and subcategories in the oil and gas industry	U	4.2.2	4.2.2
Typical ranges of gas-to-oil ratios for different types of production	NR	4.2.3	4.2.3
Tier 1 Emission Factors for Oil Exploration, 1.B.2.a.i	U	4.2.4	4.2.4
Tier 1 Emission Factors for Oil Production, 1.B.2.a.ii	NG	–	4.2.4a
Tier 1 Emission Factors for Oil Transport, 1.B.2.a.iii	NG	–	4.2.4b
Tier 1 Emission Factors for Oil Refining, 1.B.2.a.iv	NG	–	4.2.4c
Tier 1 Emission Factors for Distribution of Oil Products, 1.B.2.a.v	NG	–	4.2.4d
Tier 1 Emission Factors for Abandoned Oil Wells, 1.B.2.a.vii	NG	–	4.2.4e
Tier 1 Emission Factors for Natural Gas Exploration Segment, 1.B.2.b.i	NG	–	4.2.4f
Tier 1 Emission Factors for Natural Gas Production Segment, 1.B.2.b.ii	NG	–	4.2.4g
Tier 1 Emission Factors for Gas Processing Segment, 1.B.2.b.iii	NG	–	4.2.4h
Tier 1 Emission Factors for Gas Transmission and Storage Segment, 1.B.2.b.iv	NG	–	4.2.4i
Tier 1 Emission Factors for Distribution Segment, 1.B.2.b.v	NG	–	4.2.4j
Tier 1 Emission Factors for Post-Meter Segment, 1.B.2.b.vi	NG	–	4.2.4k
Tier 1 emission factors for fugitive emissions (including venting and flaring) from oil and gas operations in developing countries and counties with economies in transition	R	4.2.5	–

Table Title	Type of Refinement	2006 IPCC Guidelines Table Number	2019 Refinement Table Number
Typical activity data requirements for each assessment approach for fugitive emissions from oil and gas systems by type of primary source	U	4.2.6	4.2.6
Activity data values required for use in the Tier 1 approach to estimate fugitive emissions from oil and gas operations	U	4.2.7	4.2.7
Classification of gas losses as low, medium or high at selected types of natural gas facilities	R	4.2.8	–
Format for summarizing the applied methodology and basis for estimated emissions from oil and natural gas systems showing sample entries	U	4.2.9	4.2.9
Detailed Sector Split for Emissions from Fuel Transformation	NG	--	4.3.1
Estimation and reporting of fugitive emissions from fuel transformation	NG	–	4.3.2
Default Emission factors for charcoal and biochar production (g GHG / kg of charcoal (or biochar) produced)	NG	–	4.3.3
Sources of fugitive greenhouse gas emissions from coke production according to processing stage and reporting of emissions	NG	–	4.3.4
Default Emission factors for fugitive emissions from coke production	NG	–	4.3.5
Default uncertainty assessment for emission factors from Coke Production	NG	–	4.3.6
Default factors for fugitive emissions from flaring of coke oven gas	NG	–	4.3.7
Default uncertainty assessment for emission factors from coke oven gas flaring	NG	–	4.3.8
Summary of GHG emissions from gasification transformation processes	NG	–	4.3.9
Emission factors for gasification processes of CtL	NG		4.3.10
Emission factor for gasification processes of GtL	NG		4.3.11
Default uncertainty assessment for emission factors from Gasification Transformation Processes	NG		4.3.12
Correction of gas volumes to the required temperature conversion factors (CFt)	NG	–	4A.1.1
Disaggregation of Tier 1 Emission factors for Oil Exploration Segment, 1.B.2.a.i	NG	–	4A.2.1
Disaggregation of Tier 1 Emission factors for Oil Production Segment, 1.B.2.a.ii	NG	–	4A.2.2
Disaggregation of Tier 1 Emission factors for Oil Refining, 1.B.2.a.iv	NG	–	4A.2.3
Disaggregation of Tier 1 Emission factors for Gas Exploration, 1.B.2.b.i	NG	–	4A.2.4
Disaggregation of Tier 1 Emission factors for Gas Production, 1.B.2.b.ii	NG	–	4A.2.5
Disaggregation of Tier 1 Emission factors for Gas Processing Segment, 1.B.2.b.iii	NG	–	4A.2.6

Table Title	Type of Refinement	2006 IPCC Guidelines Table Number	2019 Refinement Table Number
Disaggregation of Tier 1 Emission factors for Gas Transmission Segment, 1.B.2.b.iv	NG	–	4A.2.7
Emission Factors for Gasification Processes of BtG and BtL	NG	--	4Ap.3.1

Figures

- Figures 4.1.1 - 4.1.1a: The previous decision tree was noted as available for CH_4, and new decision tree was provided for CO_2 emissions.
- Figure 4.2.0: Figure explaining the key segments included in oil and natural gas systems was newly provided.
- Figure 4.2.1: New decision tree available for whole oil and natural gas systems was provided by revising the former tree.
- Figures 4.2.2 - 4.2.3: Figures of former decision trees were incorporated to updated Figure 4.2.1 and were deleted.
- Figures 4.3.1 - 4.3.7: Decision trees and process diagrams for the subcategories of fuel transformation were newly provided.
- Figures in Appendixes: Newly provided.

Figure Title	Type of Refinement	2006 IPCC Guidelines Figure Number	2019 Refinement Figure Number
Decision tree for methane from underground coal mines	U	4.1.1	4.1.1
Decision tree for carbon dioxide from underground coal mines	NG	–	4.1.1a
Decision tree for surface coal mining	NR	4.1.2	4.1.2
Decision tree for abandoned underground coal mines	NR	4.1.3	4.1.3
Key segments included in oil and natural gas systems	NG	–	4.2.0
Decision tree for oil and natural gas systems	U	4.2.1	4.2.1
Decision tree for crude oil production	R	4.2.2	–
Decision tree for crude oil transport, refining and upgrading	R	4.2.3	–
Decision tree for Charcoal (and biochar) production	NG	–	4.3.1
Typical flow diagram of a coke oven plant showing emissions sources	NG	–	4.3.2
Decision tree for estimating fugitive emissions from coke production processes	NG	–	4.3.3
Decision tree for estimating CO_2 emissions from coke oven gas flaring	NG	–	4.3.4
Decision tree for estimating fugitive emissions of CH_4 and N_2O from coke production process	NG	–	4.3.5
Gasification transformation process of biomass, coal and gas	NG	–	4.3.6
Decision tree for estimating emissions of CO_2, CH_4 and N_2O from Gasification Transformation processes	NG	–	4.3.7
Decision tree for coal exploration	NG	--	4Ap.1.1

Figure Title	Type of Refinement	2006 IPCC Guidelines Figure Number	2019 Refinement Figure Number
Flow diagram of wood pellet production process	NG	–	4Ap.2.1
Emissions Diagram for a Typical Pellet Plant (Two Dryers)	NG	–	4Ap.2.2
Proposed decision tree for estimating fugitive emissions from wood pellet production	NG	–	4Ap.2.3

Boxes

- All Boxes were newly provided.

Box Title	Type of Refinement	2006 IPCC Guidelines Box Number	2019 Refinement Box Number
Hydrogen Production. Fugitive Emissions and Refineries	NG	–	4.2.1
Notes on catalyst regeneration and calcination	NG	–	4.2.2
Flaring activities in metallurgical coke and iron and steel production	NG	–	4.3.1
Example of Calculation of Disaggregated Emission Estimates for Oil Production	NG	–	4A.2.1