IPCC TFI work on Methodology Report on Short-lived Climate Forcers (SLCFs)

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ipcc

INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Mandate for Methodology report on SLCFs

IPCC49 (May 2019, Kyoto, Japan) decided that IPCC TFI should develop a new Methodology Report on SLCFs during AR7 cycle with a preparatory work during AR6 cycle (Decision IPCC-XLIX-7).

- **Approach**

The preparatory work for the Methodology Report (including supporting materials and scoping) is completed as soon as possible, starting in the AR6 cycle. Followed by further methodological development in the AR7 cycle

Joint 1st and 2nd IPCC Expert Meeting on SLCFs

- IPCC TFI TSU conducted extensive technical analysis of the main methodological frameworks on SLCFs source categories and associated emissions:
  - EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019
  - US EPA AP-42: Compilation of Air Pollutant Emissions Factors
  - UNEP Atmospheric Brown Clouds (ABC) Emission Inventory Manual

- This analysis was the basis for discussion at the Joint 1st and 2nd Expert Meeting. It was held in October 2021 in online format

- Working on the technical documents, this expert meeting successfully achieved its goals:
  - A complete list of SLCF source categories and associated SLCF species for all sectors – ENERGY, IPPU, AFOLU, WASTE
  - List of knowledge gaps

- All outcomes (category list, gaps' list, BOGs' discussion and conclusions, presentations and tables for each sector) are part of the meeting report published at the IPCC TFI website: https://www.ipcc-nggip.iges.or.jp/public/mtdocs/2110_SLCF.html

Technical analysis performed by IPCC TFI TSU

IPCC code	Category	SLCFs	IPCC Method	Alternative methodology	Available EFs/ Parameters	Globally applicable?	Gaps (if any)	Comments
A	B	C	D	E	F	G	H	I
2B Chemical Industry								
2B1	Ammonia production	NOx, NH3, CO, NMVOC, SOx	Yes, with modification, the method is slightly different: fuel and carbon content (IPCC-CO2) per output of ammonia vs. EF of SLCF per output of ammonia		EMEP/EEA, UNEP, US AP-42, REAS, MEP China	Yes		D: In the 2006 IPCC Guidelines, in the case of ammonia production no distinction is made between fuel and feedstock emissions with all emissions accounted for in the IPPU Sector. The method for CO2 and SLCFs is slightly different: input of fuel and its carbon content (IPCC-CO2) by output of ammonia vs. EF of SLCF by output of ammonia (SLCF). F: EMEP/EEA – NOx, CO, NH3. NMVOC - Tier2, Tier 2 - technology specific UNEP – NOx, CO, NH3, SOx, NMVOC US AP-42 – NH3, SO2, CO, NMVOC REAS – NH3 MEP China – NMVOC
2B2	Nitric Acid production	NOx, NH3	Yes		EMEP/EEA, UNEP, US AP-42	**Yes**		F: EMEP/EEA – NOx. UNEP – NOx and NH3 US AP-42 – NOx
2B3	Adipic Acid production	NOx, CO, NMVOC	Yes		EMEP/EEA, UNEP, US AP-42	**Yes**		F: EMEP/EEA – NOx, CO UNEP and US AP-42 – NOx, CO, NMVOC

Category List

IPCC code	Category	SLCFs	Comments
A	B	C	I
2B Chemical Industry			
2B1	Ammonia production	NOx, NH3, CO, NMVOC, SOx	In the 2006 IPCC Guidelines, in the case of ammonia production no distinction is made between fuel and feedstock emissions with all emissions accounted for in the IPPU Sector. The method for CO2 and SLCFs is slightly different: input of fuel and its carbon content (IPCC-CO2) by output of ammonia vs. EF of SLCF by output of ammonia (SLCF). EMEP/EEA – NOx, CO, NH3. NMVOC - Tier2, Tier 2 - technology specific UNEP – NOx, CO, NH3, SOx, NMVOC US AP-42 – NH3, SO2, CO, NMVOC REAS – NH3 MEP China – NMVOC
2B2	Nitric Acid production	NOx, NH3	EMEP/EEA – NOx. UNEP – NOx and NH3 US AP-42 – NOx
2B3	Adipic Acid production	NOx, CO, NMVOC	EMEP/EEA – NOx, CO UNEP and US AP-42 – NOx, CO, NMVOC

3rd IPCC Expert Meeting on SLCFs

- The 3rd Expert Meeting further considered issues identified at the Joint 1st and 2nd Meeting and discussed cross-cutting issues in relation to the inventory of SLCFs emissions taking into account the assessments in the IPCC WGI and WGIII contributions to AR6

- It was held in April 2022 in online format

- The discussion was focused on three main topics:
  - Definitions of SLCF species and methods of their identification/quantification
  - General inventory issues (Data Collection, KCA, UA, Verification, etc.)
  - Refined Category and Gaps' lists

The meeting report was published on the IPCC TFI website:
https://www.ipcc-nggip.iges.or.jp/public/mtdocs/2204_SLCF_EM3.html

3rd IPCC Expert Meeting on SLCFs

- The 3rd Expert Meeting concluded, among others:
  - Most BC/OC emission estimates derive from $PM_{2.5}$, so $PM_{2.5}$ information is generally available
  - The priority for NMVOC reporting is to report the total mass of VOC
  - Prioritization should be conducted by source category considering all “air pollutant SLCFs” (i.e. BC, OC, NO_X, SO_2, NH_3, NMVOCs, CO)
  - It is not recommended to use metrics to compare long-lived GHGs with SLCFs, thus those cannot be combined in a unique KCA
  - Given that sources of SLCF emissions are inherently variable and SLCF emissions are impacted by environmental conditions, consideration of spatial and temporal occurrence of emissions to relate those with climatic factors will be important in developing representative emission factors and methodologies. So, although SLCF information should be reported at minimum national and on an annual basis, finer regional disaggregation or full spatialization of emissions data along with their seasonality might therefore be needed to capture SLCF emissions accurately for some sources across all regions of the globe.

Outputs of the Joint 1st & 2nd and 3rd IPCC Expert Meetings on SLCFs

- The following materials were produced:
  - A complete list of inventory categories with respective SLCF species
  - Summary tables with relevant information on methods and EFs availability for each category from:
    - ✓ *EMEP/EEA Air Pollutant Emission Inventory Guidebook 2019*
    - ✓ *US EPA AP-42: Compilation of Air Pollutant Emissions Factors*
    - ✓ *UNEP Atmospheric Brown Clouds (ABC) Emission Inventory Manual*
  - A list of knowledge gaps
  - A list of allocation issues between different sectors
  - A note on SLCF species definition and relevance
  - A note on general inventory issues
  - A consolidated version of Volume 1 of the 2006 IPCC Guidelines and its 2019 Refinement
  - English Translation of SLCF methodologies used in China

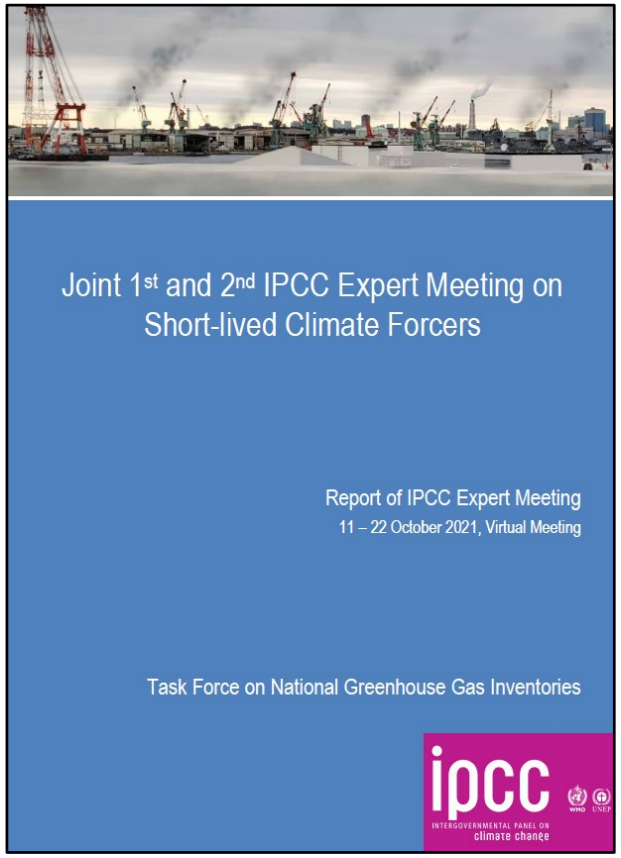
Category List – Example for Energy (excerption)

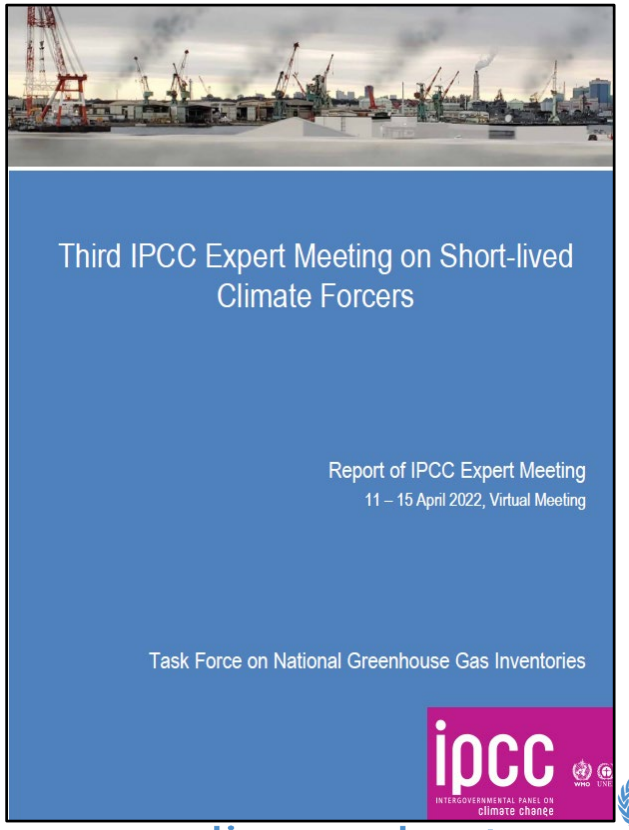
IPCC categorization	Category	SLCFs						
		NOx	NH_3	SO_2	CO	NMVOC	BC	OC
1	**ENERGY**							
1.A	**Fuel combustion activities**							
1.A.1	**Energy Industries**							
1.A.1.a.	Main activity electricity and heat production	X	X	X	X	X	X	X
1.A.1.b.	Petroleum refining	X	X	X	X	X	X	X
1.A.1.c.	Manufacture of solid fuels and other energy industries							
1.A.1.c.i.	Manufacture of solid fuels	X	X	X	X	X	X	X
1.A.1.c.ii.	Other energy industries	X	X	X	X	X	X	X
1.A.2	**Manufacturing industries and construction**							
1.A.2.a.	Iron and steel	X	X	X	X	X	X	X
1.A.2.b.	Non-ferrous metals	X	X	X	X	X	X	X
1.A.2.c.	Chemicals	X	X	X	X	X	X	X
1.A.2.d.	Pulp, paper and print	X	X	X	X	X	X	X
1.A.2.e.	Food processing, beverages and tobacco	X	X	X	X	X	X	X
1.A.2.f.	Non-metallic minerals	X	X	X	X	X	X	X
1.A.2.g.	Transport equipment	X	X	X	X	X	X	X
1.A.2.h.	Machinery	X	X	X	X	X	X	X
1.A.2.i.	Mining (excluding fuels) and quarrying	X	X	X	X	X	X	X
1.A.2.j.	Wood and wood products	X	X	X	X	X	X	X
1.A.2.k.	Construction	X	X	X	X	X	X	X
1.A.2.l.	Textile and leather	X	X	X	X	X	X	X
1.A.2.m.	Non-specified industry	X	X	X	X	X	X	X
1.A.3.	**Transport**							
1.A.3.a.	Civil aviation							
1.A.3.a.i.	international aviation (international bunkers)	X		X	X	X	X	X
1.A.3.a.ii.	Domestic aviation	X		X	X	X	X	X
1.A.3.b.	Road transportation							
1.A.3.b.i.	Cars	X	X	X	X	X	X	X
1.A.3.b.ii.	Light duty trucks	X	X	X	X	X	X	X
1.A.3.b.iii.	Heavy duty trucks and buses	X	X	X	X	X	X	X
1.A.3.b.iv.	Motorcycles	X	X	X	X	X	X	X
1.A.3.b.v	Evaporative emissions from vehicles					X		

Note on SLCF species – Example for Black Carbon (excerption)

Black Carbon	
Black carbon (BC) is the most strongly light-absorbing component of particulate matter, and is formed by the incomplete combustion of fossil fuels, biofuels and biomass[10]. Properties are: absorbing visible light at all wavelength and with a mass absorption coefficient (MAC) of *5–15 m 2 g−1 at 550 nm; insoluble in water -and common organic solvents, acids and bases-, refractory to thermal decomposition at 4000 K, aggregate morphology (carbon spherules). Many analytical protocols exist for determining BC content by thermal, chemical, molecular marker or optical methods. The choice of method depends on the nature of the matrix being analysed and on the equipment available in the laboratory. Further, matrix-specific methods are needed for soils or sediments (to access historical deposition and reconstruct past emissions)[11] Many common measurement methods do not quantify this material specifically, instead reporting a proxy like light absorption or refractory component, with names like "effective black carbon" (eBC) or "elemental carbon" (EC). EPA's National Emissions Inventory and SPECIATE particulate matter composition database use EC to represent BC. Analytical differences create uncertainty in emission factors and predicted light absorption[12]	
1. Definition:	A solid form of mostly pure carbon that absorbs solar radiation at all wavelengths and is produced by incomplete combustion (Black Carbon Report to Congress, 2012).
2. Measurement methods:	Different methods applied to measure BC provides for different BC types: ✓ *Based on light absorption (equivalent black carbon[13] - eBC[14]): Aethalometers, Light absorption/reflectance (MAAP), CLAP, PSAP, denuder/light absorption (COSMOS[15] or BCM); Photo-acoustic (PASS)* ✓ *Based on r refractory[16] properties (refractory black carbon - rBC): Laser induced incandescence, SP2;* ✓ *Based on combustion properties: (elemental carbon - EC): Thermo-optical (TOT);* Or as a fraction of $PM_{2.5}$
Reference/Source:	Caria et al. 2011 http://dx.doi.org/10.1111/j.1475-2743.2011.00349.x Bond et al. 2006 https://www.tandfonline.com/doi/full/10.1080/02786820500421521 Chow et al. 2004 https://pubs.acs.org/doi/10.1021/es034936u Chow et al. 2007 https://www.tandfonline.com/doi/pdf/10.3155/1047-3289.57.9.1014 Gysel et al. 2011 https://amt.copernicus.org/articles/4/2851/2011/ Kondo et al. 2011 https://www.tandfonline.com/doi/full/10.1080/02786826.2010.533215 Petzold et al. 2013 https://acp.copernicus.org/articles/13/8365/2013/acp-13-8365-2013.html; https://acp.copernicus.org/preprints/13/9485/2013/acpd-13-9485-2013.pdf Pileci et al. 2021 https://amt.copernicus.org/articles/14/1379/2021/

IPCC TFI Publications on SLCFs (Meeting Reports)





https://www.ipcc-nggip.iges.or.jp/public/mtdocs/1805_Geneva.html
https://www.ipcc-nggip.iges.or.jp/public/mtdocs/2110_SLCF.html
https://www.ipcc-nggip.iges.or.jp/public/mtdocs/2204_SLCF_EM3.html

Production Cycle of Methodology Report

Scoping meeting to produce Table of Contents, Terms of Reference, Workplan

TFB proposes ToC, ToR, WP to IPCC61

IPCC61 approves the proposal

Call for Nominations of Authors

Scoping

Approval of Outline

Nomination of authors

The outline is drafted and developed by experts nominated by governments and observer organizations

The Panel then approves the outline

Governments and observer organizations nominate experts as authors

Selection of Authors. Preparation for Lead Author Meeting (LAM1)

LAM3 (SOD)

LAM1 (ZOD)
LAM2 (FOD)

Government and Expert Review - 2nd Order Draft

Expert Review - 1st Order Draft

Selection of authors

LAM4 (FD)

IPCCXX approves the report

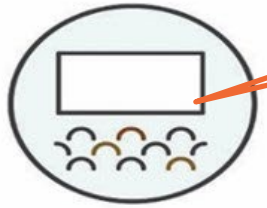
Authors prepare the Second Order Draft (SOD) which is reviewed by experts and Governments

Authors prepare the First Order Draft (FOD) which is reviewed by experts

TFB selects authors

Final Draft (FD) Report

Goverment review of the FD



Approval & acceptance of report

Authors prepare the Final Draft (FD) which is sent to Governments before approval

Governments review the FD in preparation for its approval

Adoption of the Overview Chapter (section by section) and acceptance of Methodology Report

Publication of report

It takes around 3 years (2024-2026)

Scoping process

- At IPCC53-bis session (March 2021) the Scoping Meeting was moved from AR6 to AR7 cycle
- The nomination letter for the Scoping Meeting was sent by IPCC Secretariat to the IPCC Focal Points and Observer Organizations on 5 May 2023
- TSU collected nominations received by the end of August 2023
- In November 2023 TFB considered the list of nominated experts and selected participants for the Scoping Meting taking into account the expertise, regional and gender balance. The invitation for participants was sent out on November 21, 2023.
- The Scoping Meeting will take place on 26-28 February 2024 in Sydney, Australia

Scoping Meeting (expected outcomes)

- The Scoping Meeting shall **discuss and decide on** the following:
  - **Title** and **Format** of the new **Methodology Report on SLCFs**
  - Draft **Terms of Reference** of the Methodology report
  - Draft **Table of Contents**
  - Draft **Workplan**
  - Draft **Instructions to Experts and Authors**

- The outcomes of the Scoping Meeting will be considered by TFB in order to make a proposal to the IPCC Panel (IPCC 61)

Table of Contents – 2006 IPCC Guidelines *(excerption)*

Table of Contents for 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Overview

Volume 1: Cross-cutting Issues and Reporting Tables
This volume will integrate existing material[2] relevant to cross-cutting issues listed below. A more complete discussion on approaches to data[3] collection (e.g. sampling, use of expert judgement in data collection) will be provided. Specific information on the topics listed below will also be elaborated at the sectoral level.

- Overview
- Approaches to Data Collection
- Uncertainties
- Methodological Choice and Identification of Key Categories
- Time Series Consistency and Recalculation
- Quality Assurance/Quality Control and Verification
- Reporting Guidance including Tables

Volume 2: Energy
This volume will integrate and update existing material[2] relevant to the Energy Sector. As appropriate, it will provide methodologies and default data to cover emissions of new sources (see criteria in TOR)[4]

- Overview and cross-cutting issues
- Reference Approach
- Stationary Combustion
- Mobile Combustion[5]
- Fugitive Emissions

Volume 3: Industrial Processes and Product Use
This volume will integrate existing material[2] relevant to Industrial Processes and Solvent and Other Product Use Sectors. It will update as necessary the existing material on current source categories. As appropriate, it will provide methodologies and default data to cover emissions of new halogenated gases. It will also develop methodologies for selected new sources (see criteria in TOR):

- Overview and cross-cutting issues
- Chemical industry emissions
- Metal industry emissions
- Mineral industry emissions
- Non-energy product and feedstock use of fuels
- Ozone precursors from industrial processes
- Other industrial process emissions

Potential Workplan for the new Methodology Report

Date	Action	Actors	Comments
February 2024	Scoping Meeting	Participants	Prepare ToR, ToC, Workplan and Guidance to authors
February 2024	TFB36 Meeting	TFB	Adoption of Outcomes of the Scoping Meeting and Submission to IPCC
March- April 2024	IPCC-61	TFI Co-Chairs	IPCC Plenary approves ToR, ToC, Workplan and Guidance to authors
April 2024	Call for Nomination of Authors and Review Editors	TSU	IPCC invites nominations from governments and international organizations
June 2024	Establishment of the Steering Committee	TFB	TFB select members to join TFI Co-Chairs in the Steering Group *(to ensure consistency across all the volumes and continuity with the earlier IPCC inventory reports)*
June 2024	Selection of Coordinating Lead Authors, Lead Authors and Review Editors	TFB	Selection by TFB considering expertise and geographical and gender balance
Autumn 2024	1st Lead Author Meetings	Authors	LAM1 to develop zero order draft (ZOD)
Spring 2025	2nd Lead Author Meeting	Authors	To develop first order draft (FOD) for review
3rd quarter 2025 (8 weeks)	Expert Review	Experts	8 weeks review by experts
4th quarter 2025	Science Meeting	Authors	A small meeting of CLAs and some LAs to discuss specific issues that require intensive discussion to reinforce the writing process
4th quarter 2025	3rd Lead Author Meeting	Authors	To consider comments and produce second order draft (SOD) for review
1st quarter 2026	Literature cut-off date	Authors	Only papers published before this date will be considered
1st quarter 2026 (8 weeks)	Government & Expert Review	Governments Experts	8 weeks review by governments and experts
2nd quarter 2026	4th Lead Author Meeting	Authors	To consider comments and produce final draft (FD)
3rd quarter 2026	Government Review	Governments	Distribute to governments for their consideration prior to approval (at least 4 weeks prior to the Panel)
4th quarter 2026 – 1st quarter 2027	Adoption/acceptance by IPCC	Authors TFI Co-Chairs	Final draft submitted to IPCC Panel for adoption/acceptance
1st quarter 2027	Publication	TSU	Electronic means

Thank you

https://www.ipcc-nggip.iges.or.jp/index.html

https://www.ipcc-nggip.iges.or.jp/meeting/meeting.html

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