The IPCC 2006 Guidelines and their evolution from the Revised 1996 Guidelines

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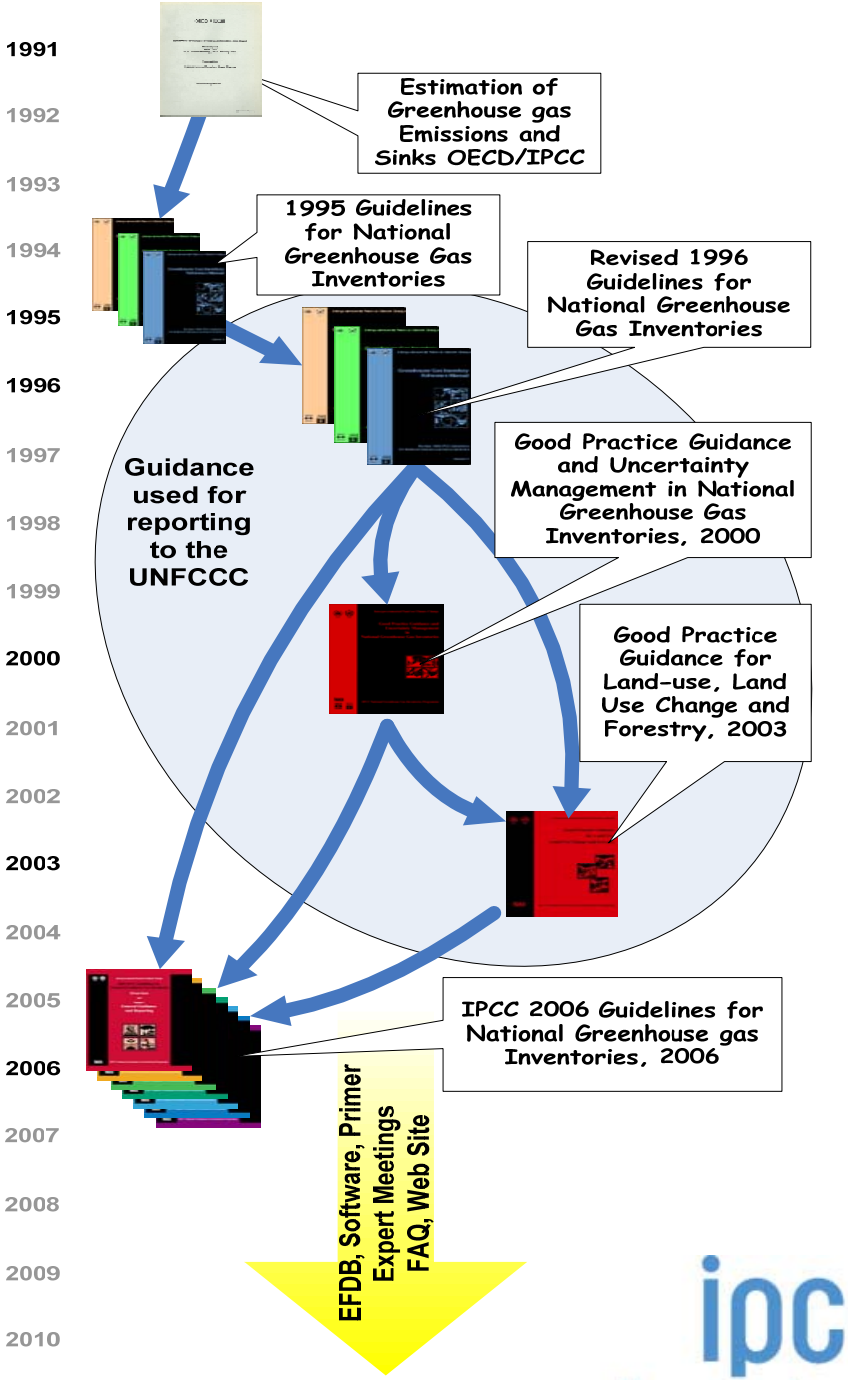
INTERGOVERNMENTAL PANEL ON climate change

Introduction

- History and Evolution of IPCC Guidelines
- General Issues
- Sectoral Issues
  - Energy
  - IPPU
  - AFOLU
  - Waste
- Continuing work after the 2006 Guidelines

History

- Process started in 1991
- Revised 1996 Guidelines
  - Land-Use Change and Forestry (LUCF) identifies major land use processes
- 2000 Good Practice Guidance and Uncertainty Management
  - Defines GPG for sectors except LUCF
- Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG LULUCF)
  - Expanded guidance covering all pools
  - Land-based not process-based
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories
  - Now only 4 main sectors: Energy, IPPU (Industrial Processes and Product Use), AFOLU (Agriculture, Forestry and Other Land Use) and Waste



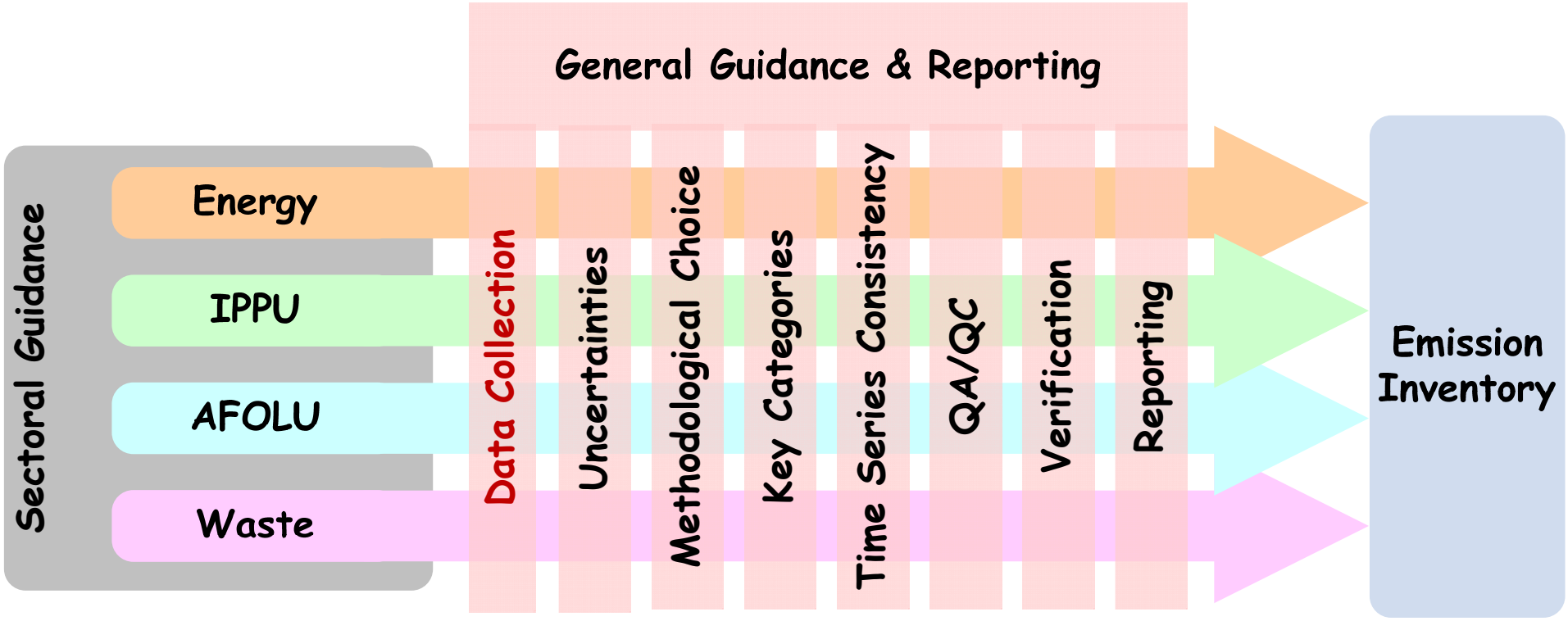
IPCC Guidelines for GHG emission inventories

- IPCC Guidelines give globally applicable methods and default parameters for estimates from nearly all sources while providing a framework for the consistent use of more detailed, accurate, country specific methods
- Development of Good Practice Guidance (GPG) a major step forward
  - Complete, consistent, comparable, transparent, and accurate inventories taking account of available resources
  - Major methodological change was from 1996 LUCF to GPG LULUCF
    - 1996 Guidelines focus main processes, LULUCF & AFOLU focus on all land
    - This increase in completeness and accuracy also increases data & resource needs.
    - In contrast, changes from LULUCF to 2006 Guidelines (AFOLU) are small
- 2006 Guidelines [2.5 years work, 250 authors]
  - Completed at request from UNFCCCC
  - A completed update and revision of earlier guidance
  - Integrates GPG with sectoral guidance – guidance complete

Good Practice Guidance - GPG

- Updated and complemented earlier guidelines
- GPG Inventories are: "those that contain neither over- nor under-estimates so far as can be judged, and in which uncertainties are reduced as far as is practical"
- GPG inventories are complete, consistent, comparable, transparent, and accurate while taking account of available resources
- Managed land is used in these guidelines as a proxy for identifying anthropogenic emissions by sources and removals by sinks.
  - use of managed land as a proxy for anthropogenic effects was introduced in the GPG-LULUCF and is consistent with the Revised 1996 Guidelines.

GPG and Sectoral Guidance



2006 Guidelines

- Updates and expands earlier guidelines while remaining consistency with earlier guidelines
- Restructure main categories and sub-sectors to clarify and simplify inventories and to reduce chance of double-counting
  - Agriculture + LULUCF ➔ AFOLU
  - Industrial Processes + Solvent Use ➔ IPPU
- Integrates good practice guidance for clarity and ease of use
  - Require similar resources to implement as the 1996 Guidelines plus the two volumes of GPG
  - Does not pre-empt accounting choices - all the information needed is retained
- Includes
  - updated default values and methods
  - methods for sectors previously included in other sectors or under “other”
  - methods for additional direct greenhouse gases
- The best globally applicable methods

Methodological approaches unchanged

- ✓ Continued from 1996 Guidelines, through GPG 2000 & LULUCF to 2006 Guidelines:

Emission = [Activity Data] x [Emission Factor]

- In General:
  - Energy emissions
    - Based on carbon content of fuel
  - Industrial Processes
    - Based on chemistry of process
    - Some use mass balance of product used
  - Land Use
    - Stock changes ⇒ Emissions/Removals
    1. Inputs (e.g. growth) - outputs (e.g. decay, harvest)
    2. Total Stock at end minus Total stock at beginning
  - Waste
    - Tracks carbon (fossil & biogenic) in waste

Estimation of Direct, Actual Annual Emissions

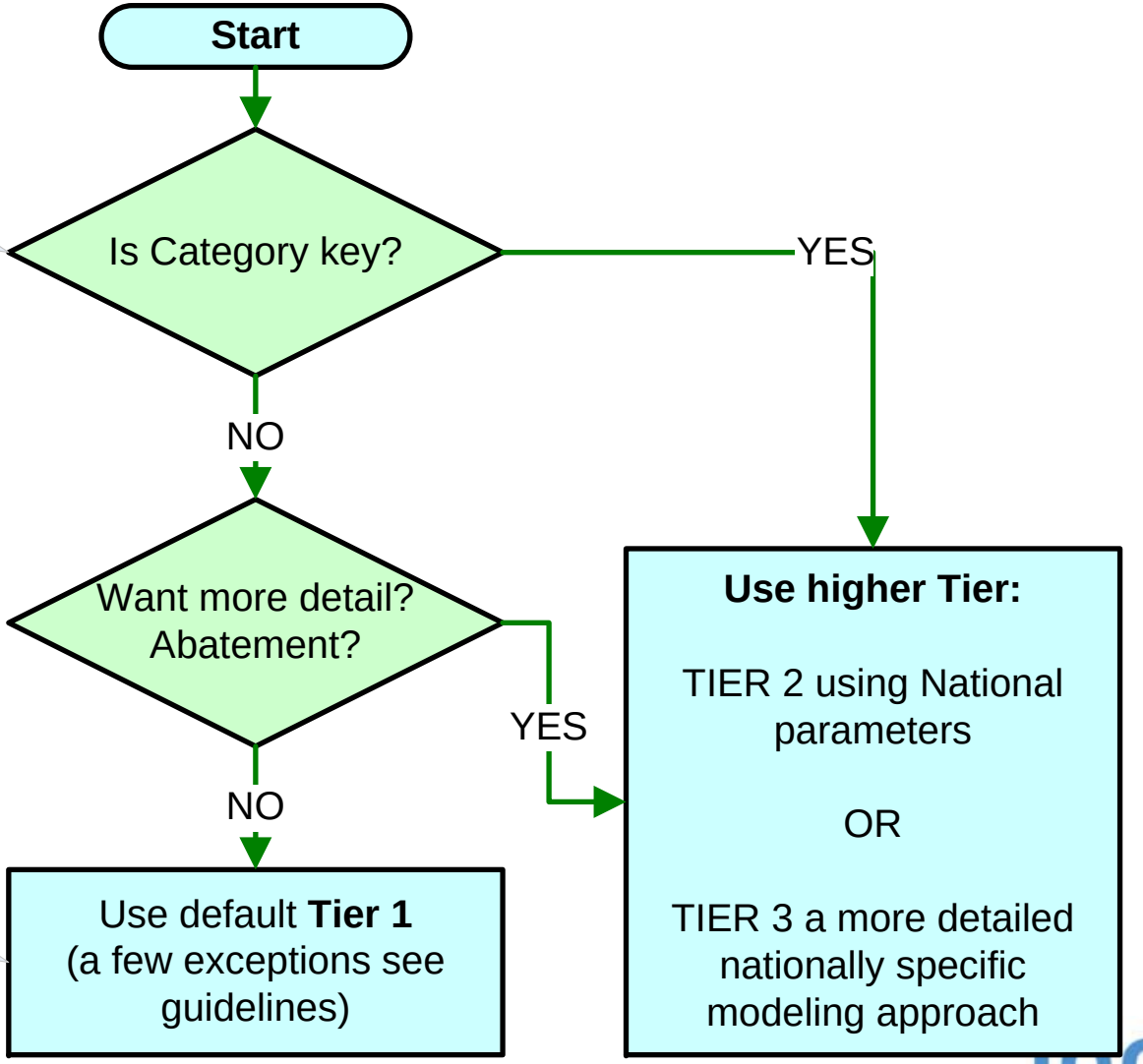
- 2006 Guidelines: Only carbon emitted as CO_2 is included in the "CO_2 emissions and removals".
  - Additional carbon is emitted as other gases (CH_4, CO etc.) and converted to CO_2 in the atmosphere. A method is given to estimate and document this additional CO_2
- Earlier Guidelines estimated indirect N_2O from the deposition of NO_x and NH_3 from agricultural sources only – 2006 Guidelines includes all sources.
  - Agricultural sources reported in AFOLU - 3.C.5 & 3.C.6, similar to GPG LULUCF (4D)
  - Emissions from all other sources of NO_x and NH_3 ARE reported in Category 5.A "where a country already has an inventory of [NO_x and NH_3]"
- For a few sources (i.e. F-gas & landfills) in the 1996 Guidelines & GPG, the simplest methodology estimates a "potential emission" (current and future emissions) rather than the actual annual emission.
  - In the 2006 Guidelines, simple default methods estimate actual annual emissions for all categories in the year they occur, thus removing the need for potential emissions.

Annual Emissions Estimates

- Revised 1996 Guidelines allowed averaging ONLY for LUCF and Agriculture
  - "while the IPCC *Guidelines* request an emission figure for a single year in most source/sink sectors, three-year averages (with the base year in the middle) are preferred in the areas of agriculture and land use change/forestry."
- Averaging less clear in GPG 2000 & LULUCF
  - "Usually, available data will represent an annual average for an estimation parameter or an annual total for activity data."
  - "Since there is a large degree of uncertainty in determining the burned area in each savanna ecosystem, it may be useful to take an average of at least three years to provide a base year estimate for identification of any trend in the emissions of CH_4 and N_2O from savanna burning."
- 2006 Guidelines aims at "best" possible annual emission estimates
  - "National inventories contain estimates for the calendar year during which the emissions to (or removals from) the atmosphere occur. Where suitable data to follow this principle are missing, emissions/removals may be estimated using data from other years applying appropriate methods such as averaging, interpolation and extrapolation."

Tiers and Key Categories

Key category: The largest categories that cumulatively add up to 95% of the total



Tier 1: The simplest method with default parameters in the guidleines

"New" gases in 2006 Guidelines – Sources Identified in 2006 Guidelines

Sources only in IPPU Sector

By-product & fugitive emissions

	Electronics Industries	Magnesium production	Halogenated Compounds Production	GWP in TAR	GWP in AR4
nitrogen trifluoride (NF_3)	✓		✓	✓	✓
trifluoromethyl sulphur pentafluoride (SF_5CF_3)			✓	✓	✓
halogenated ethers (e.g. $C_4F_9OC_2H_5$, $CHF_2OCF_2OC_2F_4OCHF_2$, $CHF_2OCF_2OCHF_2$)	✓		✓	✓	✓
CF_3I, CH_2Br_2, $CHCl_3$			✓	✓	
C_7F_{16} , CH_2Cl_2, CH_3Cl			✓	✓	✓
$C_3F_7C(O)C_2F_5$		✓	✓		
C_4F_6, C_5F_8, c-C_4F_8O	✓		✓		

Carbon Dioxide Equivalence

- 2006 IPCC Guidelines **do not specify** any particular parameters to convert mass of a gas to a equivalent mass of CO_2 – users need to choose…
  - e.g. Kyoto Protocol uses GWP from IPCC SAR with 100 year time horizon
  - IPCC also has newer GWP values in TAR and AR4
  - Other alternatives to GWP have been discussed
- Used only for:
  - IPPU to aggregate the various fluorinated gases
  - Key Category Analysis
  - Uncertainty Assessment

Improved Guidance in 2006 Guidelines

Fuel Combustion

- CO_2 -Transport and Storage
- Urea-based Catalysts (Road Transport)

Fugitive Emissions from Fuels

- Abandoned Underground Mines

Mineral Industry

- Glass Production
- Ceramics
- Non Metallurgical Magnesia Production

Chemical Industry

- Ammonia & Urea Production
- Caprolactam, Glyoxal & Glyoxylic Acid
- Titanium Dioxide Production
- Petrochemical and Carbon Black Production

Metal Industry

- Lead Production
- Zinc Production

Electronics Industries

- Integrated Circuit or Semiconductor
- TFT Flat Panel Display
- Photovoltaics
- Heat Transfer Fluid

Other Product Manufacture and Use

- Electrical Equipment
- Military Applications
- Accelerators
- Medical Applications
- Propellant for Pressure and Aerosol Products

Substitutes for Ozone Depleting Substances

Land Use

- Complete, consistent treatment of fires
- N_2O from land management and change
- Settlements remaining Settlements
- Peatlands and some flooded land categories
- Urea Application
- Indirect N_2O Emissions from Manure Management
- Harvested Wood Products

Waste

- Open Burning of Waste
- Biological Treatment of Solid Waste

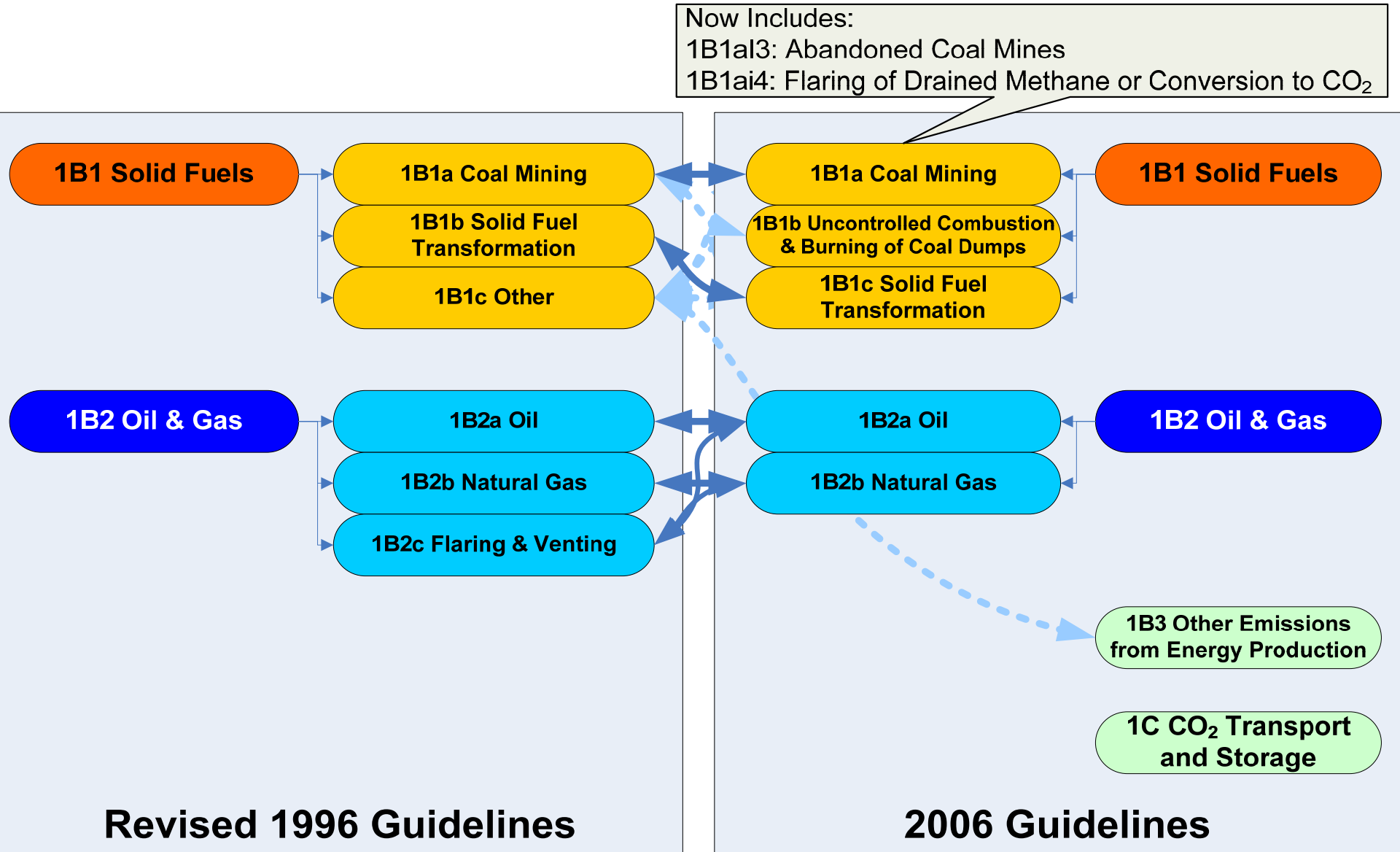
Other

- Indirect N_2O Emissions from the Atmospheric Deposition of N (excluding agriculture)

Energy Sector – Fuel Combustion

- Methods and categories largely unchanged
- Improved default emission factors for fossil fuel use,
  - based on survey of global data
  - uncertainties derived from range of data
- 1A2 “Manufacturing Industries and Construction” – suggested list of sub-categories to be reported, extended to include:
  - Mining (excluding fuels) and Quarrying, Wood and Wood Products, Construction, Textile and Leather
- New category: Road transport: Urea-based catalysts
  - Improved handling of Urea production and use

Energy Sector – Fugitive Emissions



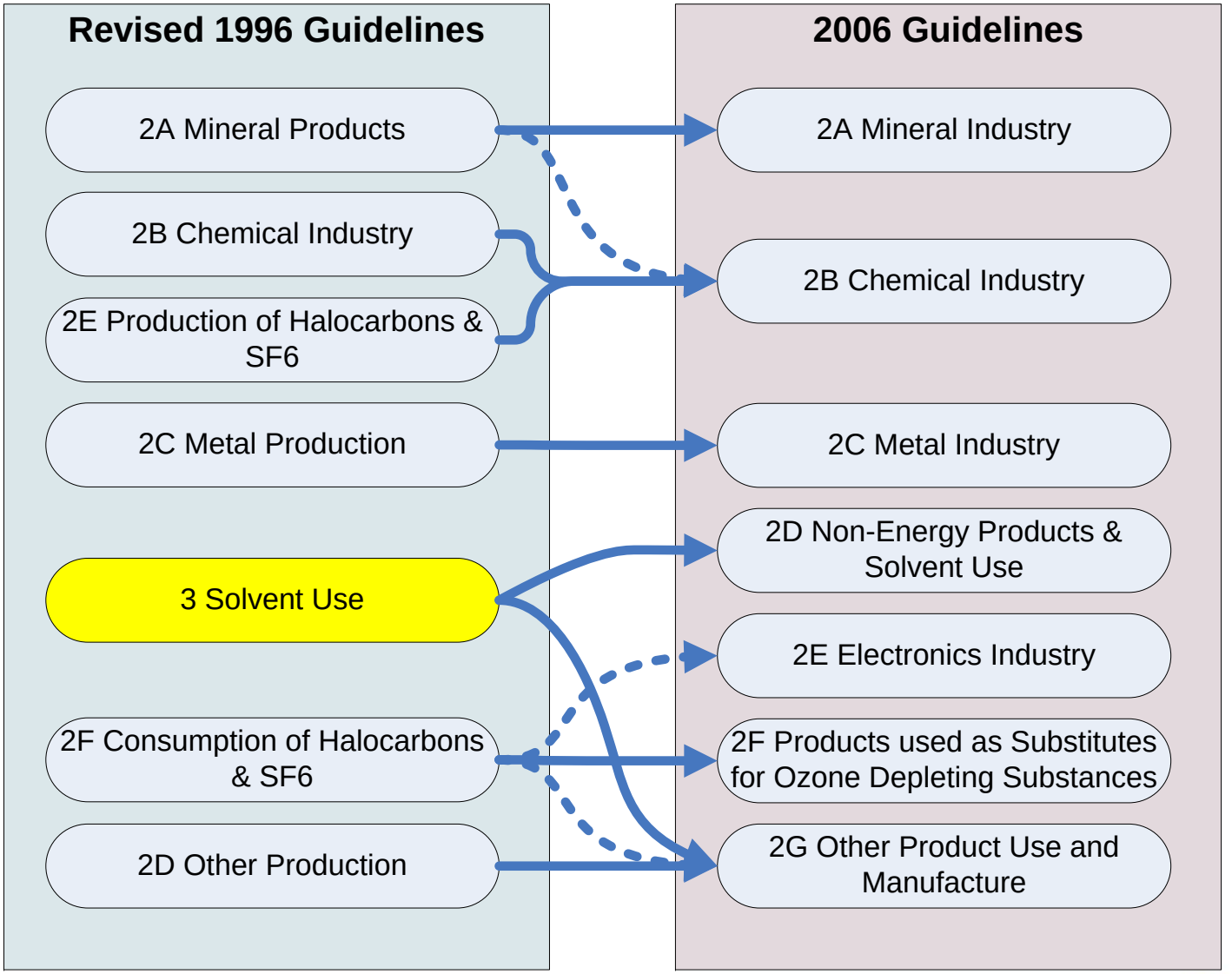
Carbon Dioxide Capture and Storage

- The possible impact of Carbon Dioxide Capture and Storage (CCS) is covered comprehensively in the 2006 Guidelines:
  - fugitive losses from CO_2 capture and transport stages (estimated using conventional inventory approaches)
  - any losses from carbon dioxide stored underground (estimated by a combination of modelling and measurement techniques, - which would also be monitored for management purposes).
    - no assumptions of leakage rates are made
  - methods reflect the actual emissions in the year in which they occur.
  - methods are consistent with the IPCC Special Report on Carbon Dioxide Capture and Storage (2005).
  - CO_2 captured from combustion of bio-fuels, are included in the inventory as a "negative emission" so that no distinction is needed between any subsequent leakage of this CO_2 and that of CO_2 from fossil sources.

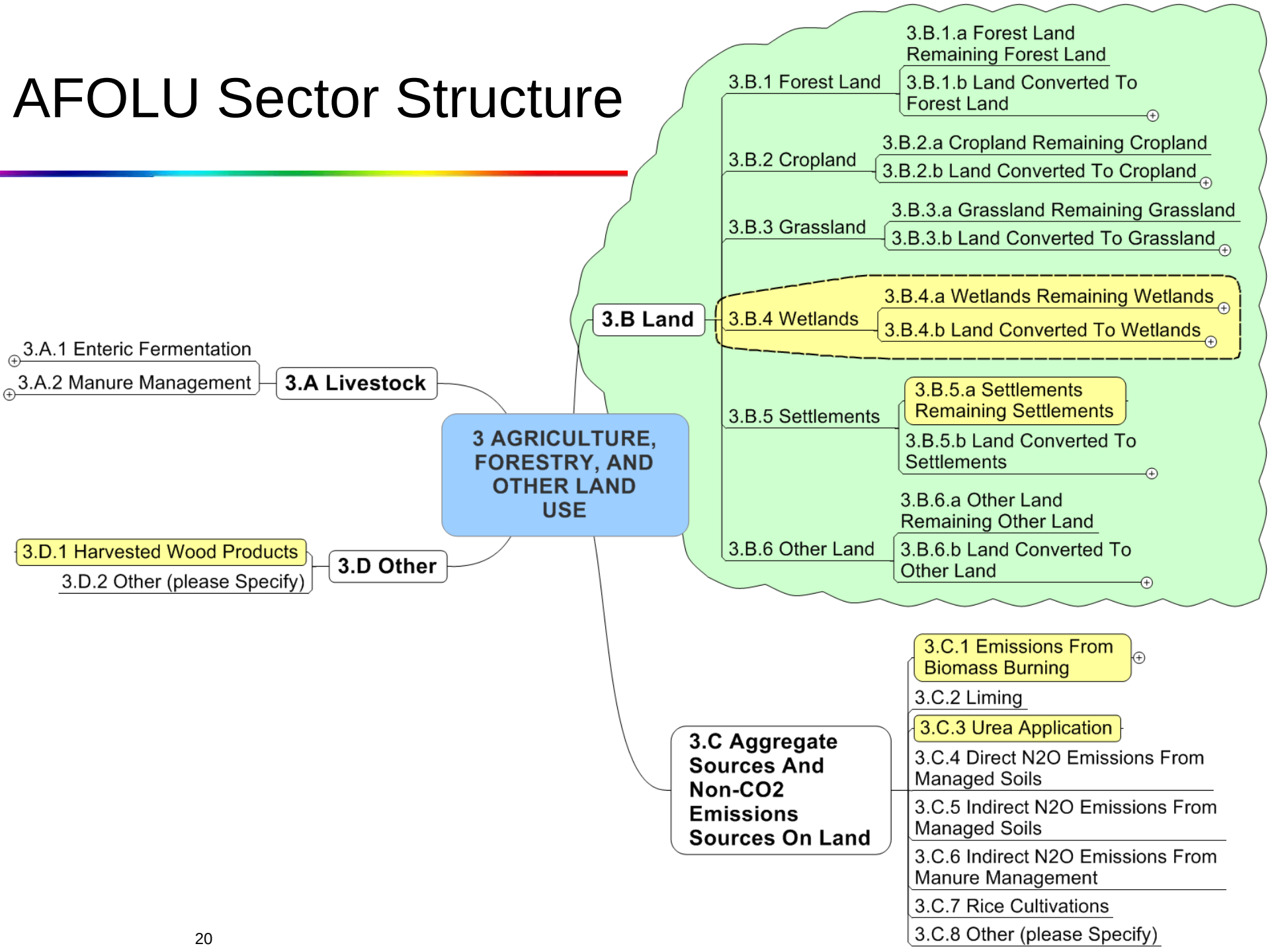
IPPU ≈ Industrial Processes + Solvent Use

- Solvent Use does not have much direct GHG emissions (it is mainly NMVOC) while the use of products is broader than solvent use and can result in emissions
- Quantities of CO_2 for later use and short-term storage should not be deducted from CO_2 emissions except when the CO_2 emissions are accounted for elsewhere in the inventory
  - e.g. urea and methanol production
  - Ensures completeness and consistency,
- Non-Energy Uses of Fossil Fuels
  - Guidance on demarcation between the Energy and Industrial Processes and Product Use sectors has been improved,
  - Emissions from non-energy uses of fossil fuels are now reported under IPPU, rather than in Energy.
  - A method has been introduced for checking the completeness of carbon dioxide emission estimates from the non-energy uses.
- To increase transparency several sources that were combined in other categories are reported separately in the 2006 Guidelines

Industry & Solvent Classification



AFOLU Sector Structure



2006 IPCC Guidelines Category			Revised 1996 Guidelines &GPG LULUCF	
Name		Category	Category	Name
Enteric Fermentation		3.A.1	4.A	Enteric Fermentation
Manure Management		3.A.2	4.B	Manure Management
These categories only include CO_2,	Forest Land	3.B.1	5.A (CO_2 Only)	Forest Land
	Grassland	3.B.2	5.B (CO_2 Only)	Grassland
	Crop Land	3.B.3	5.C (CO_2 Only)	Crop Land
	Wetlands	3.B.4	5.D (CO_2 Only)	Wetlands
	Settlements	3.B.5	5.E (CO_2 Only)	Settlements
	Other Land	3.B.6	5.F (CO_2 Only)	Other Land
Biomass Burning in Forestlands		3.C.1.a	Included in 5.A	Biomass Burning in Forestlands
Biomass Burning in Crop Lands *(Note 1)*		3.C.1.b	4.F	Burning of Agricultural Wastes
			Included in 5.C	Biomass Burning in Crop Lands (Other)
Biomass Burning in Grasslands *(Note 1)*		3.C.1.c	4.E	Burning
			Included in 5.B	Biomass Burning in Grasslands (Other)
Biomass Burning in All Other Lands		3.C.1.d	Included in 5.D, 5.E, 5.F	Biomass Burning in Wetlands, Settlements and Other Lands

2006 IPCC Guidelines Category		Equivalent Category in the Revised 1996 Guidelines PLUS GPG LULUCF	
Name	**Category**	**Category**	**Name**
Liming	3.C.2	5.A to 5.F	Liming
Urea Application	3.C.3	IE	Urea Application
Direct N_2O Emissions from Managed Soils	3.C.4	4.D.1	Direct Soil Emissions
		4.D.2	Paddock Manure
		Included in 5.A, 5.D, 5.E, 5.F	Direct N2O Emissions from N fertilisation in Forest Land And Other
Indirect N_2O Emissions from Managed Soils	3.C.5	4.D.3	Indirect Emissions
Indirect N_2O Emissions from Manure Management	3.C.6		
Rice Cultivations	3.C.7	4.C	Rice Cultivations
Other	3.C.8	4.D	Other sources of CH_4 and N_2O on Land
HWP	3.D.1	5.G	HWP
Other	3.D.2	4.G	Other
		5.G (minus HWP)	Other

Harvested Wood Products (HWP)

- In previous guidelines default method was that

  HWP emissions = amount harvested

  – (i.e. Default assumption is that HWP pool remains constant)
- Various accounting approaches have been proposed to report HWP emissions
- 2006 Guidelines
  – Provides methods (and spreadsheet) for estimating some underling parameters from which results for all of the proposed accounting methods can be estimated.
  – Allow users to decide on accounting approach
  – If a single accounting approach were adopted guidelines could reflect this.

Improvements in AFOLU Guidance

- Wetlands
  - 2006 GL has complete coverage of peatlands
  - 2006 GL improved coverage of flooded lands but some guidance is incomplete and awaits further scientific investigation
- Fires
  - Guidelines have increased consistency and coverage of fires
  - All emissions from fires reported in a separate category for increased transparency
- Disturbances
  - In GPG emissions from disturbance need not be reported if removals from subsequent re-growth are also not included.
  - In 2006 GLs these emissions are both reported
    - removals from re-growth may not equal emissions from the disturbance (e.g. loss of soil fertility)

Waste

- Landfill sites Solid Waste Disposal
  - New Tier 1 model (spreadsheet available)
  - Only estimate actual emissions at all Tiers
- New guidance for Biological Treatment of Waste
  - Previously reported under “Other”
- 2006 GL has separate categories for “Uncategorised Waste Disposal Sites” and “Open Burning of Waste”
- All emissions from waste disposal with energy recovery and waste used for energy reported in Energy Sector.

Sectoral Summary

- ✓ Energy Largely Unchanged
  - ❖ Improved defaults for fossil fuel combustion
  - ❖ Some additional categories
    - ➢ e.g. CCS, Road Transport Urea Catalysts, uncontrolled burning of coal dumps
    - ➢ Fugitive Emission categories simplified and clarified
- ✓ IPPU
  - ❖ More process emissions identified
  - ❖ Chemical production and use coverage clarified
  - ❖ Mapping from GPG to 2006 Guidelines straightforward
- ✓ Integration of agriculture & LULUCF reduces chance of double counting or omissions – some simplification of categories
  - ❖ The AFOLU Guidance in the 2006 Guidelines maintains the basic structure, definitions and methods of the GPG LULUCF
  - ❖ Mapping from GPG to 2006 Guidelines classification is straightforward with care on dealing with fires and biomass burning.
  - ❖ AFOLU effort and data requirements much the same as for LULUCF & Agriculture
- ✓ Waste Largely Unchanged
  - ❖ Significant improvement to default method for landfills.

Expert Meetings

- Sao Paulo 2009 (Managed Land)
  - No current alternative to the use of “managed land” as a proxy for identifying anthropogenic emissions was identified for widespread global use - Possible alternatives need further scientific development and subsequent assessment
- Rome (2009) (Land use and agriculture data)
  - Developed a guide to FAO data for inventory compilers
- Utrecht (2010) (Uncertainties)
  - Developed Q&A on uncertainty analysis and reviewed use of measurements in inventory validation

National Forest GHG Inventories: A Stock Taking - Yokohama (2010)

- Areas where additional guidance may be useful:
  - Design of forest monitoring systems
    - inventory design, stratification (particularly in dynamic landscapes) , sampling, pools and accuracy/uncertainty assessment;
  - Combination of ground based inventories with remote sensing and modeling approaches;
  - Use of remote sensing data in forest GHG inventories
    - stratification, change assessment and use of remote sensing methods for biomass estimation;
  - Guidance on selectively logged forests.
  - Data on emission factors and parameters have improved since the 2006 Guidelines were finalised
    - e.g. BEF/BCEF data and emission factors for peat lands.

Other Activities

- EFDB
  - Additional resources for TSU to support this
  - Data meetings to collect data
- 2006 GL Software
  - Planned for end 2010
- Web site
  - FAQ
  - Presentations
  - Primer and other publications

2006 Guidelines:

- ✓ The same basic methodological approaches are used from 1996 Guidelines, through GPG 2000 & GPG LULUCF to 2006 Guidelines
- ✓ The 2006 Guidelines maintain the methods of earlier guidelines and integrate GPG
  - ➢ Improved guidance in some areas, more and improved default data
    - ➢ Wider coverage of gases
    - ➢ Additional sources covered explicitly
    - ➢ All estimates are now of actual annual emissions ("potential" emissions not needed)
    - ➢ Categories simplified and clarified in some areas
  - ➢ Does not pre-empt accounting choices - all the information needed is retained
- ✓ TFI has continued supporting users of the guidelines
  - ➢ Expert Meetings
  - ➢ Software and EFDB
  - ➢ FAQ, website etc.

Thank you

Guidelines in all UN languages can be downloaded from

http://www.ipcc-nggip.iges.or.jp

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