

# Quality Assurance/Quality Control and Verification

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INTERGOVERNMENTAL PANEL ON climate change

# What do we want?

- Overall: a high quality inventory of anthropogenic emissions and removals of greenhouse gases (GHG) that is credible & convincing
- Indicators of quality:

## TCCCA

- Transparency
- Completeness
- Consistency
- Comparability
- Accuracy

# Transparency

- There is sufficient and clear documentation such that individuals or groups other than the inventory compilers can understand how the inventory was compiled and can assure themselves it meets the *good practice* requirements for national greenhouse gas emissions inventories.

## *Relevant chapters in the 2006 IPCC Guidelines*

- Chapter 8, Reporting Guidance and Tables, of Volume 1
- Chapter 6, QA/QC and Verification, of Volume 1
- respective chapters (sectoral guidance) of Volumes 2-5

# Completeness

- Estimates are reported for all relevant categories of sources and sinks, and gases. Geographic areas within the scope of the national greenhouse gas inventory are recommended in these *Guidelines*. Where elements are missing their absence should be clearly documented together with a justification for exclusion.

## *Relevant chapters in the 2006 IPCC Guidelines*

- Chapter 8, Reporting Guidance and Tables, of Volume 1
- respective chapters (sectoral guidance) of Volumes 2-5.

# Consistency

- Estimates for different inventory years, gases and categories are made in such a way that differences in the results between years and categories reflect real differences in emissions. Inventory annual trends, as far as possible, should be calculated using the same method and data sources in all years and should aim to reflect the real annual fluctuations in emissions or removals and not be subject to changes resulting from methodological differences.

## Relevant chapters in the 2006 IPCC Guidelines

- Chapter 2: Approaches to Data Collection, of Volume 1
- Chapter 4: Methodological Choice and Identification of Key Categories, of Volume 1
- Chapter 5: Time Series Consistency, of Volume 1

# Comparability

- The national greenhouse gas inventory is reported in a way that allows it to be compared with national greenhouse gas inventories for other countries. This comparability should be reflected in appropriate choice of key categories and in the use of the reporting guidance and tables and use of the classification and definition of categories of emissions and removals.

*Relevant chapters in the 2006 IPCC Guidelines*

- Chapter 8, Reporting Guidance and Tables, of Volume 1



# Accuracy

- The national greenhouse gas inventory contains neither over- nor under-estimates so far as can be judged. This means making all endeavours to remove bias from the inventory estimates

## Relevant chapters in the 2006 IPCC Guidelines

- Chapter 2, Approaches to Data Collection, of Volume 1
- Chapter 3, Uncertainties, of Volume 1 and respective chapters (sectoral guidance) of Volumes 2-5.

# Good Practice

- ◆ National inventories of anthropogenic greenhouse gas emissions and removals consistent with good practice are those which:
  - ✓ contain neither over- nor under-estimates so far as can be judged, and
  - ✓ reduce uncertainties as far as practicable.



# What do we need?

- A good QA/QC system
- Tools to focus resources on where we get the maximum benefit
  - Key Category Analysis
  - Uncertainty Management
- An inventory plan covering QA/QC, timing, deliverables and stakeholder involvement
- Consistent management to achieve this

# What is “Quality Control”?

- System of routine technical activities to assess and maintain the quality of the inventory as it is being compiled
- Performed by personnel compiling the inventory
- QC system is designed to:
  - Provide routine and consistent checks to ensure data integrity, correctness, and completeness
  - Identify and address errors and omissions
  - Document and archive inventory material and record all QC activities

# What is “Quality Assurance”?

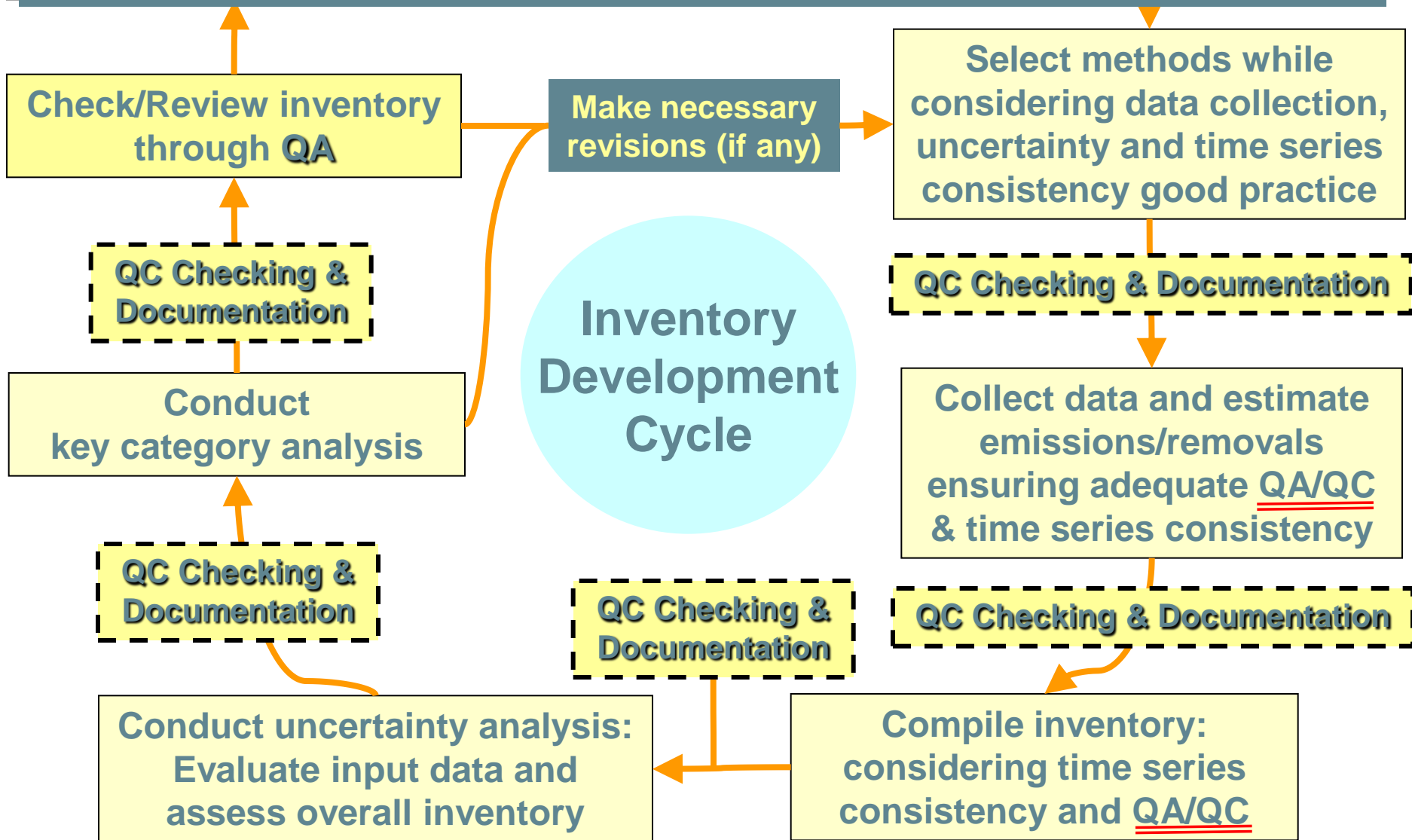
- Planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process (preferably by independent third parties)
- Performed upon a completed inventory following the implementation of QC procedures
  - Verify that measurable objectives were met
  - Ensure that the inventory represents the best possible estimates given the current state of scientific knowledge and data availability
  - Support the effectiveness of the QC programme

# What is “Verification”?

- Collection of activities and procedures conducted during the planning and development, or after completion of an inventory that can help to establish its reliability for the intended applications of the inventory
- Methods that are external to the inventory and apply independent data, including comparisons with inventory estimates made by other bodies or through alternative methods
- May be constituents of both QA and QC

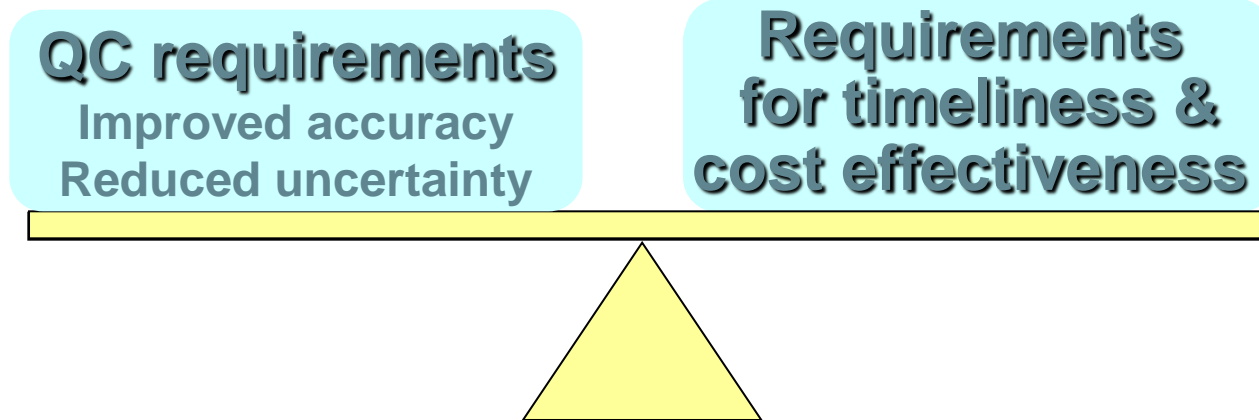
Start new estimate, building on experience

# QA/QC and verification activities should be integral parts of the inventory process



# Practical Considerations

- Seek to achieve the balance of both requirements



- Also seek to enable continuous improvement of inventory estimates

# Practical Considerations

- Try to identify where to focus more intensive analysis and review. To that end, some questions should be asked, for example:
  - ✓ Is this source/sink a key category?
  - ✓ Has the category been designated as key for qualitative reasons? For example:
    - Is there considerable uncertainty associated with the estimates for this category?
    - Have there been significant changes in the characteristics of this category, such as technology changes or management practices?
  - ✓ Does the methodology use complex modelling steps or large inputs from outside databases?
- No difference between confidential and publicly available data; both should carry descriptions of the measurement and calculation procedures and the steps taken to check and verify the values reported.

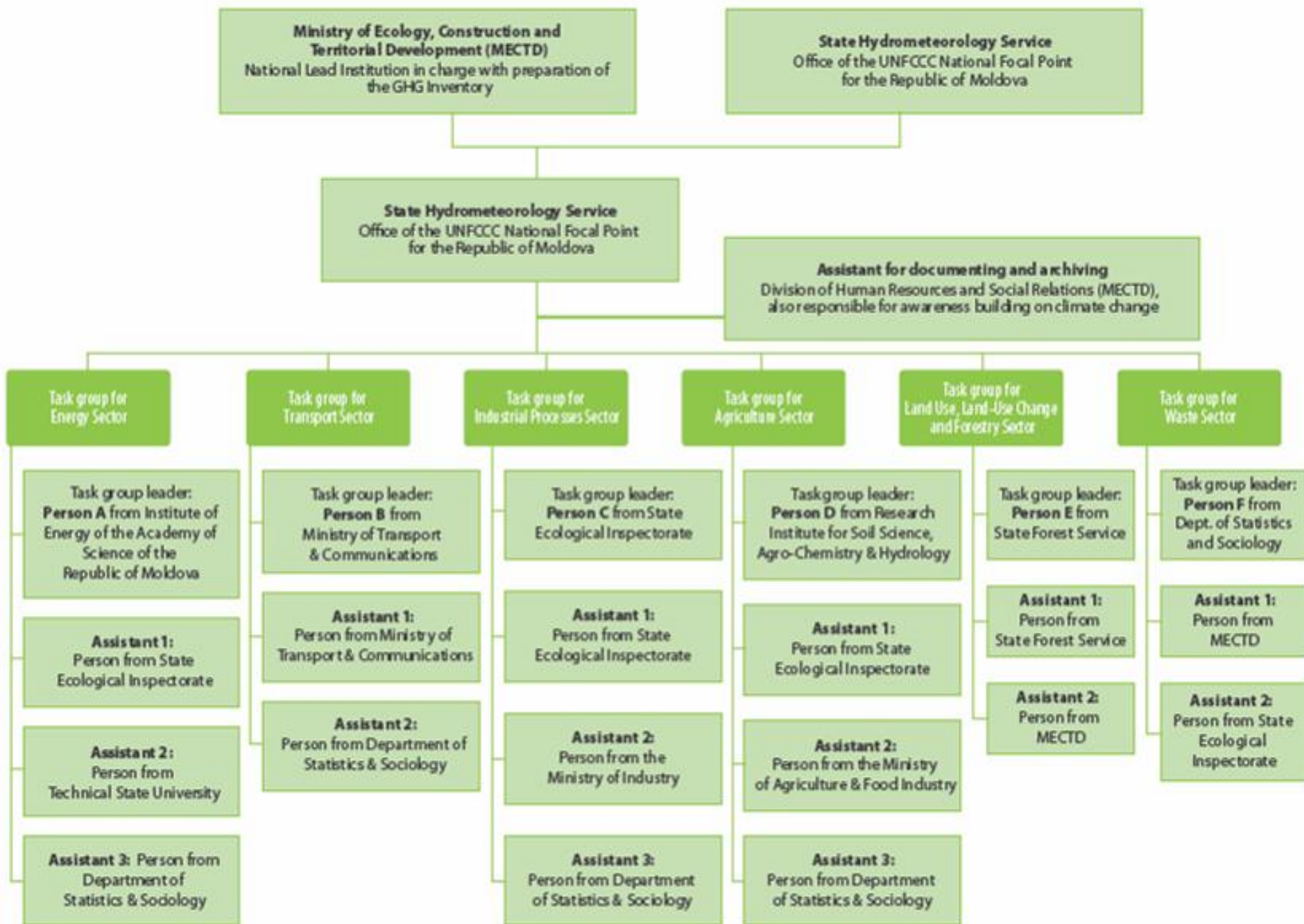


# Major Elements

- Participation of an inventory compiler who is also responsible for:
  - coordinating QA/QC and verification activities, and
  - definition of roles/responsibilities within the inventory
- A QA/QC plan
- General QC procedures that apply to all inventory categories
- Category-specific QC procedures
- QA and review procedures
- QA/QC system interaction with uncertainty analyses
- Verification activities
- Reporting, documentation, and archiving procedures

# Roles and Responsibilities

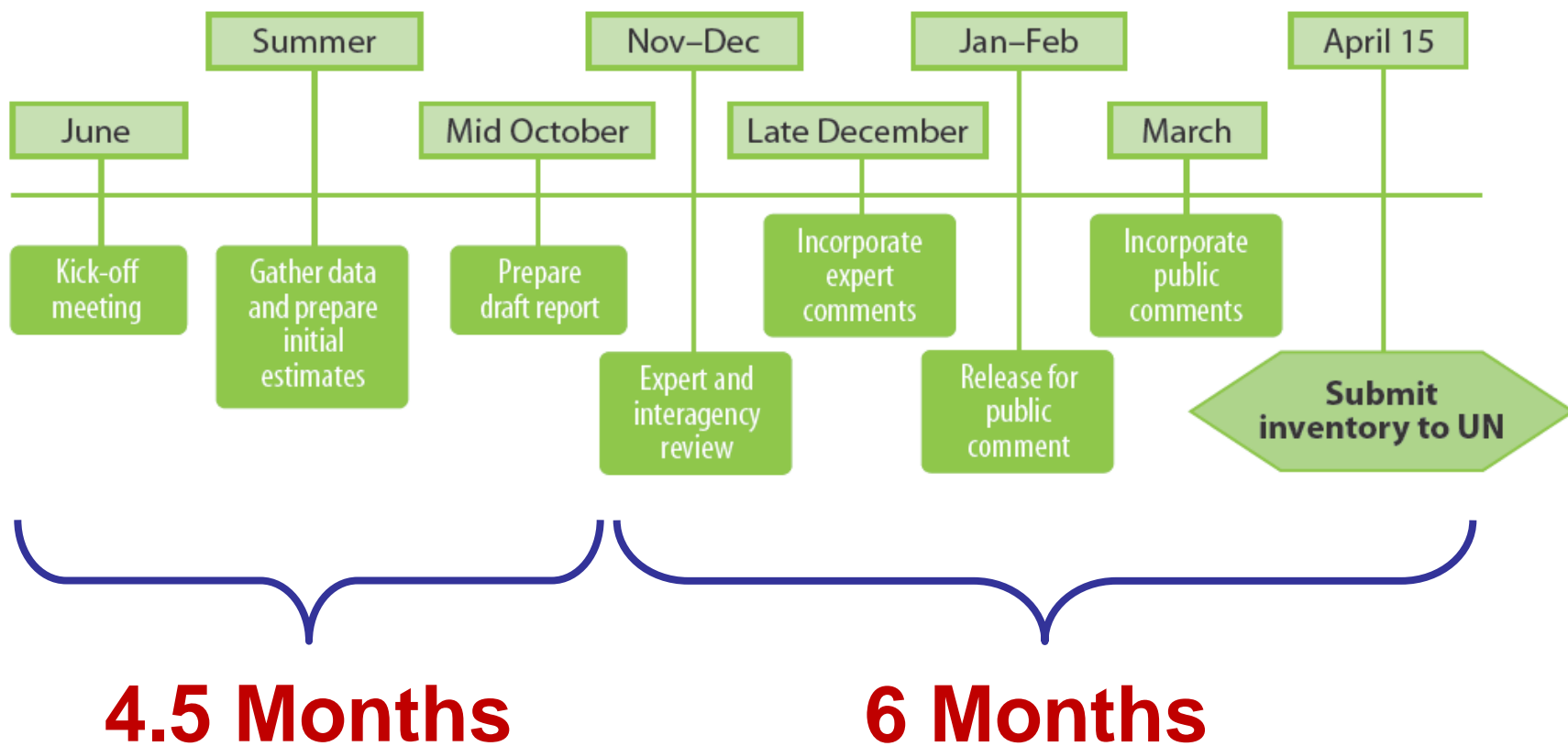
- The inventory compiler should:
  - Be responsible for coordinating the institutional and procedural arrangements for inventory activities.
  - Define specific responsibilities and procedures for the planning, preparation, and management of inventory activities.



# QA/QC Plan

- Fundamental element of the system
- Should include a scheduled time frame for the QA/QC activities
- A key component – List of data quality objectives (preferably measurable)
- Important to accommodate procedural changes and a feedback of experience
  - The periodic review and revision of the QA/QC plan is an important element to drive the continued inventory improvement.
- It may be useful to refer to relevant standards and guidelines published by outside groups involved in inventory development.
  - For example, the International Organization for Standardization (ISO) introduced specifications for quantification, monitoring, and reporting of greenhouse gas emissions and removals (ISO 14064) in organisations.

# Example: US Inventory Cycle



Source: "Managing the National Greenhouse Gas inventory Process" (UNDP National Communications Support Unit, 2005)

# General QC Procedures

- Generic quality checks applicable to all source and sink categories, related to:
  - Calculations
  - Data processing
  - Completeness
  - Documentation
- Automated checks are encouraged where possible – to effectively check large quantities of input data
- In the cases where estimates are prepared by outside consultants or agencies, the inventory compiler should ensure:
  - the consultants/agencies are aware of the QC procedures, and
  - these procedures are performed and recorded.

See Table 6.1 in Chapter 6 in Volume 1

*The checks suggested in this table should be applied irrespective of the types of data used to develop the inventory estimates.*

See also Appendix 6A.1 “QC checklists” in Chapter 6, Volume 1.



For more details, see  
Chapter 6 in Volume 1.

**TABLE 6.1**  
**GENERAL INVENTORY QC PROCEDURES**

QC Activity	Procedures
Check that assumptions and criteria for the selection of activity data, emission factors, and other estimation parameters are documented.	<ul style="list-style-type: none"> <li>• Cross-check descriptions of activity data, emission factors and other estimation parameters with information on categories and ensure that these are properly recorded and archived.</li> </ul>
Check for transcription errors in data input and references.	<ul style="list-style-type: none"> <li>• Confirm that bibliographical data references are properly cited in the internal documentation.</li> <li>• Cross-check a sample of input data from each category (either measurements or parameters used in calculations) for transcription errors.</li> </ul>
Check that emissions and removals are calculated correctly.	<ul style="list-style-type: none"> <li>• Reproduce a set of emissions and removals calculations.</li> <li>• Use a simple approximation method that gives similar results to the original and more complex calculation to ensure that there is no data input error or calculation error.</li> </ul>
Check that parameters and units are correctly recorded and that appropriate conversion factors are used.	<ul style="list-style-type: none"> <li>• Check that units are properly labelled in calculation sheets.</li> <li>• Check that units are correctly carried through from beginning to end of calculations.</li> <li>• Check that conversion factors are correct.</li> <li>• Check that temporal and spatial adjustment factors are used correctly.</li> </ul>
Check the integrity of database files.	<ul style="list-style-type: none"> <li>• Examine the included intrinsic documentation (see also Box 6.4) to:               <ul style="list-style-type: none"> <li>- confirm that the appropriate data processing steps are correctly represented in the database.</li> <li>- confirm that data relationships are correctly represented in the database.</li> <li>- ensure that data fields are properly labelled and have the correct</li> </ul> </li> </ul>



# Category-specific QC Procedures

- Complements general QC procedures
- Directed at specific types of data used in the methods for individual source or sink categories
- Applied on a case-by-case basis focusing on:
  - key categories
  - categories where significant methodological and data revisions have taken place

See also Appendix 6A.1 “QC checklists” in Chapter 6, Volume 1.

# QA Procedures

- Activities outside the actual inventory compilation, performed preferably by third party reviewers who are independent from the inventory compiler
  - Expert peer review
  - Audits
- Priority should be given to:
  - key categories
  - categories where significant methodological and data revisions have taken place

# QA/QC and Uncertainty Estimates

- Provide valuable feedback to each other on critical components of the inventory estimates and data sources that:
  - Contribute to both the uncertainty level and inventory quality
  - Should therefore be a primary focus of inventory improvement efforts
- Uncertainty analysis can provide insights into:
  - Weaknesses in the Estimate
  - Sensitivity of the estimate to different variables
  - The greatest contributors to uncertainty

# Verification

- Activities to provide information for countries to improve their inventories
  - Comparisons of national estimates
    - Applying different tier methods
    - Comparisons with independently compiled estimates
    - Comparisons of intensity indicators between countries
  - Comparisons with atmospheric measurements

# Documentation, Archiving and Reporting

- Document and archive all information relating to the planning, preparation, and management of inventory activities
  - Records of QA/QC procedures are important information to enable continuous improvement to inventory estimates.
- Report a summary of implemented QA/QC activities and key findings as a supplement to each country's national inventory

# Resources

- How much is required?
- With a very limited budget what can be done?
- How can the 2000+ pages of the 2006 Guidelines be implemented with few resources, experienced people or budget?

# If resources limited :

- Roughly 15-20 categories account for 95% of emissions
  - Identify these and concentrate resources on them (Key Category Analysis).
- Other sources use “Tier 1” methods
- Main effort is collecting activity data – use defaults for emission factors
- Look for national statistics already collected, co-operate in collecting new data
- International data sources can be used (IEA, FAO, ICAO etc.)



# Summary

- ❖ Inventories need to be credible and believable - they need to be of high quality.
- ❖ Keep in mind the indicators of quality “**TCCCA**”.
- ❖ QA/QC and verification activities should be integral parts of the inventory process.
- ❖ Seek to achieve the balance of:
  - ✓ QC requirements
  - ✓ Requirements for timeliness & cost effectiveness
- ❖ Initial planning and good management is essential.
- ❖ Limited resources is not a barrier to Greenhouse Gas Inventory compilation.

**Thank you for your attention**