Quality Assurance/Quality Control (QA/QC) Plan and Procedures and Key Category Analysis (KCA)

Remote Training on the Building of Sustainable National Greenhouse Gas Inventory Management Systems

John Watterson (QA/QC), Céline Gueguen (KCA)

Ricardo Energy & Environment, on behalf of the U.S. Environmental Protection Agency

Wednesday 9th, 2024

Housekeeping

Chat and Q&A

- Please feel free to introduce yourselves in the Chat channel - **Name, Country, Organization and Role**
- Please place questions in the chat channel or wait to ask them in the Q&A

Recording

- Today's session will be recorded, so you can view it again later

Agenda

5 min	Welcome and Introduction	John Watterson
15 min	Template 4: Quality Assurance/Quality Control (QA/QC) Plan and Procedures	John Watterson
5 min	Mentimeter poll on QA/QC	Serena Churchill
20 min	Template 4: QA/QC Plan and Procedures Walk Through	John Watterson
10 min	Q&A	John Watterson
5 min	Break	
5 min	Mentimeter poll on KCA	Serena Churchill
35 min	Template 5: Key Category Analysis (KCA)	Serena Wartmann
10 min	Q&A	Serena Wartmann
5 min	Conclusions and Next Webinairs	John Watterson

Overview

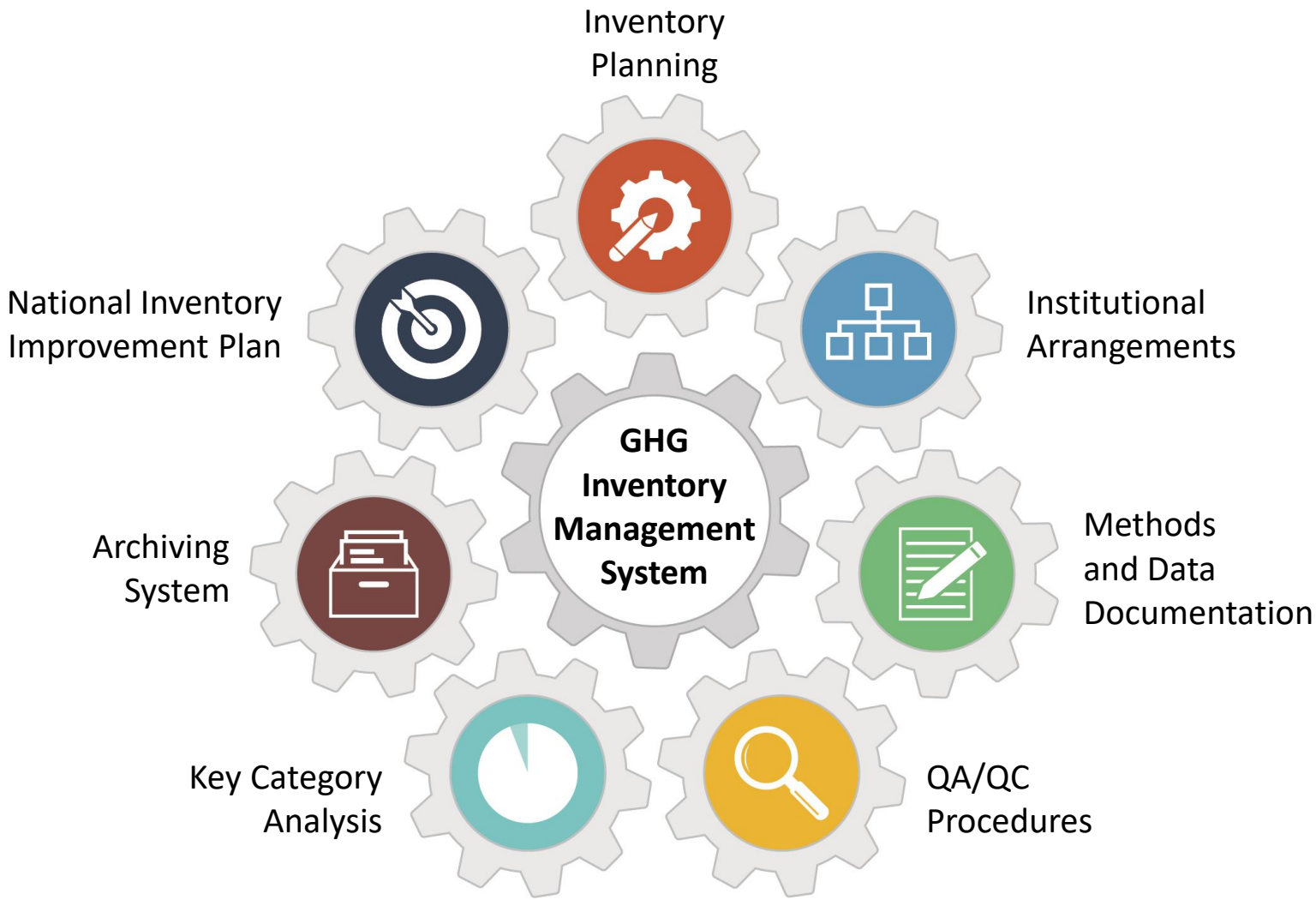
Template 4 – QA/QC Plan and Procedures

- Review difference and importance between:
  - The concepts of QA and QC
  - General procedures and sector/category-specific procedures
- Walk through the (draft) updated Template

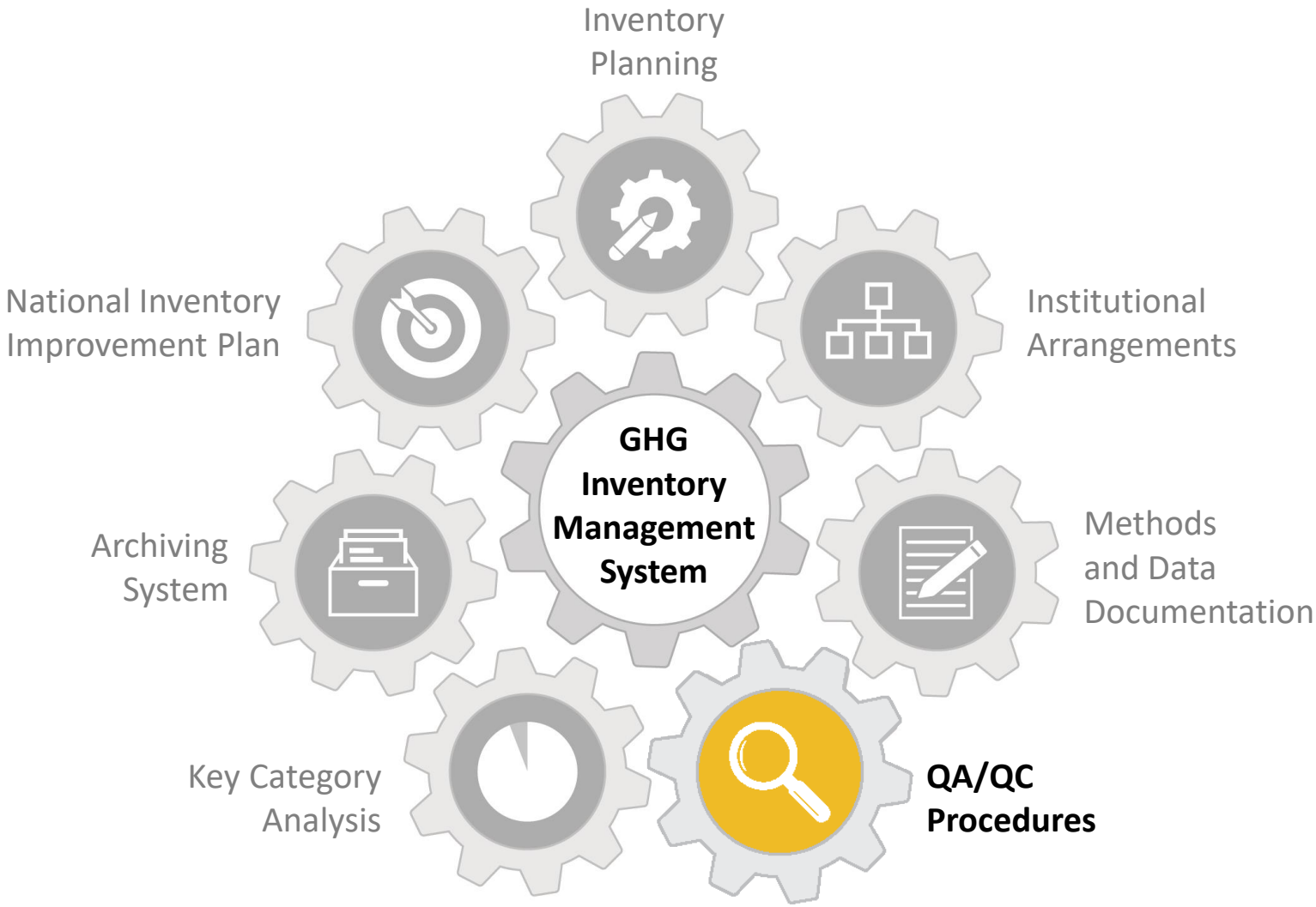
Template 5 – Key Category Analysis

- Why prioritizing within the Inventory is helpful and necessary
- Different methods to identify your key categories

Developing a Sustainable National GHG Inventory System



Quality Assurance (QA) and Quality Control (QC)



Importance of QA/QC – Why bother?

Helps identify improvement options!

Builds confidence in national GHG inventories!

What is Quality Assurance (QA)?

A planned system of review procedures conducted by personnel **not directly involved** in the inventory compilation/development process.

Reviews, *preferably by independent third parties*, are performed upon a completed inventory following quality control procedure. Reviews:

- Verify the data quality objectives were met;
- Ensure that the inventory represents the best possible estimates of emissions and sinks;
- Support the quality control program.

What is Quality Control (QC)?

A system of routine technical activities to assess and maintain the quality of the inventory as it is being compiled. **It is performed by personnel compiling the inventory**.

The 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;
- Check data acquisition, calculations, and procedures;
- Document technical reviews of data, methods, and results

Verification

- Verification refers to the collection of activities and procedures conducted during the planning and development, or after completion of an inventory that can help to establish its reliability.
- Verification activities include comparisons with emission or removal estimates prepared by other bodies and comparisons with estimates derived from fully independent assessments – such as from inverse modelling.

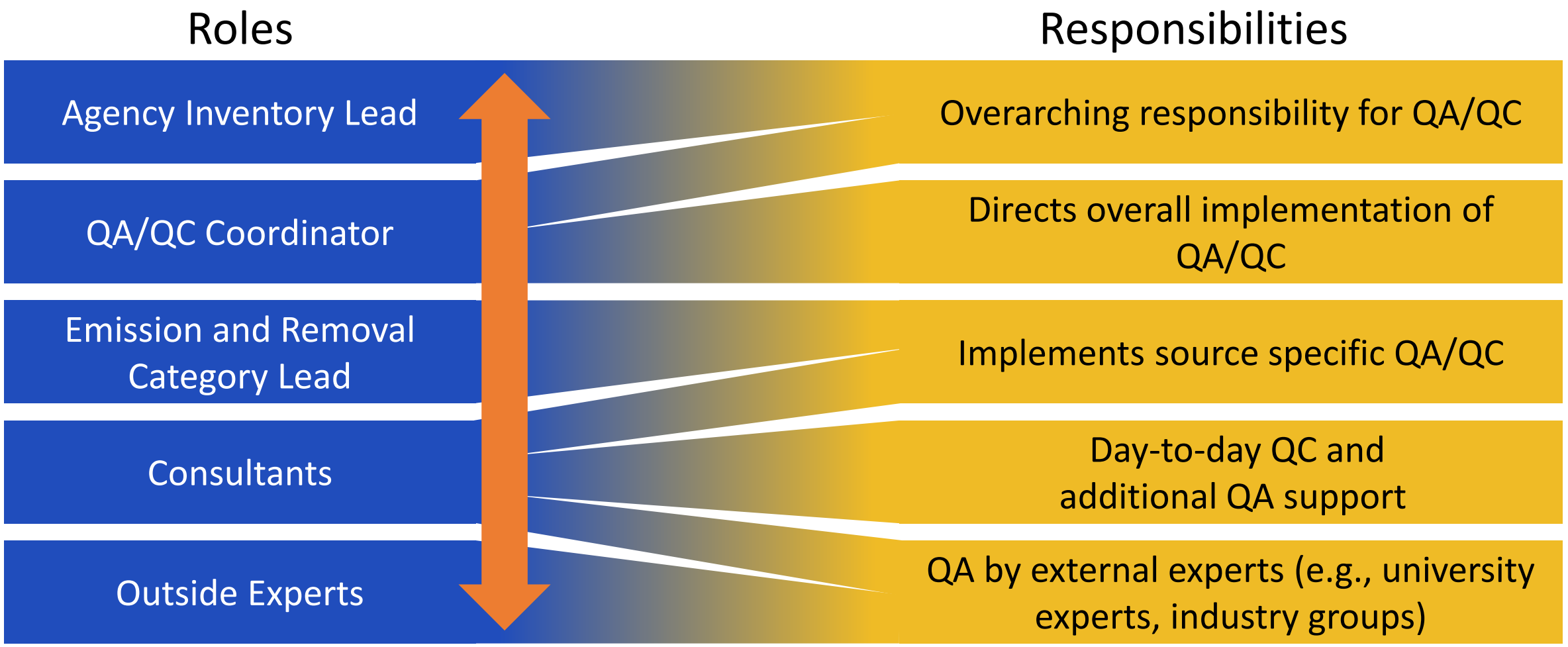
Example from 2006 IPCC Guidelines

The IPCC provides potential outside verification checks in the national level CO_2 emissions estimates compiled by the International Energy Agency (IEA)

Key Components of a QA/QC and Verification System

- Work your way round the steps in this system
- Develop an improvement plan and implement as you complete the activities – then go round the steps again – continuous improvement

QA/QC Roles and Responsibilities



One person can have multiple roles. Not all roles are full time!

General Quality Control Procedures

Apply at category and cross-cutting levels

- Data gathering, input, and handling activities
- Data documentation
- Calculating emissions and checking calculations
- Check overall data has been aggregated properly from lower levels
- *Consider adding quality control procedures relevant to country specific compilation processes (e.g., data used in figures and tables QC)*

See IPCC 2006 GLs Volume 1, Table 6.1 and additional examples for documenting QC implementation are in Annex 6A1)

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.	• 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.
Check for transcription errors in data input and references.	• Confirm that bibliographical data references are properly cited in the internal documentation. • Cross-check a sample of input data from each category (either measurements or parameters used in calculations) for transcription errors.
Check that emissions and removals are calculated correctly.	• Reproduce a set of emissions and removals calculations. • 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.
Check that parameters and units are correctly recorded and that appropriate conversion factors are used.	• Check that units are properly labelled in calculation sheets. • Check that units are correctly carried through from beginning to end of calculations. • Check that conversion factors are correct. • Check that temporal and spatial adjustment facto
Check the integrity of database files.	• Examine the included intrinsic documentation (i - confirm that the appropriate data proc represented in the database. - confirm that data relationships are co database. - ensure that data fields are properly labe design specifications. - ensure that adequate documentation of da and operation are archived.
Check for consistency in data between categories.	• Identify parameters (e.g., activity data, const multiple categories and confirm that there is co for these parameters in the emission/removal cal
Check that the movement of inventory data among processing steps is correct.	• Check that emissions and removals data are lower reporting levels to higher reporting summaries. • Check that emissions and removals data are co different intermediate products.
Check that uncertainties in emissions and removals are estimated and calculated correctly.	• Check that qualifications of individuals provi uncertainty estimates are appropriate. • Check that qualifications, assumptions and expe • Check that calculated uncertainties are complete • If necessary, duplicate uncertainty calculations probability distributions used by Monte Carlo a uncertainty calculations according to Approach
Check time series consistency.	• Check for temporal consistency in time series in • Check for consistency in the algorithm/met throughout the time series. • Check methodological and data changes resultin • Check that the effects of mitigation activitie reflected in time series calculations.

TABLE 6.1 (CONTINUED)
GENERAL INVENTORY QC PROCEDURES

QC Activity	Procedures
Check completeness.	• Confirm that estimates are reported for all categories and for all years from the appropriate base year to the period of the current inventory. • For subcategories, confirm that entire category is being covered. • Provide clear definition of 'Other' type categories. • Check that known data gaps that result in incomplete estimates are documented, including a qualitative evaluation of the importance of the estimate in relation to total emissions (e.g., subcategories classified as 'not estimated', see Chapter 8, Reporting Guidance and Tables).
Trend checks.	• For each category, current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain any differences. Significant changes in emissions or removals from previous years may indicate possible input or calculation errors. • Check value of implied emission factors (aggregate emissions divided by activity data) across time series. - Do any years show outliers that are not explained? - If they remain static across time series, are changes in emissions or removals being captured? • Check if there are any unusual and unexplained trends noticed for activity data or other parameters across the time series.
Review of internal documentation and archiving.	• Check that there is detailed internal documentation to support the estimates and enable reproduction of the emission, removal and uncertainty estimates. • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. • Check that the archive is closed and retained in secure place following completion of the inventory. • Check integrity of any data archiving arrangements of outside organisations involved in inventory preparation.

Procedures to Apply Quality Control

Example General Quality Control Checks

1. Check that spreadsheets use consistent units, properly labelled
2. Check that estimates are reported for all source categories and for all years
3. Cross-check spreadsheet values to publication values
4. Trend checks (e.g., can be automated, i.e., to check implied emission factor over time series, check for unexplained trends)

Example Category-Specific Quality Control Checks

1. Check for fuel consumption year to year trends (Energy sector)
   Follow up with external sources when fuel consumption inputs show unusual trends
2. Mass balance checks (Energy sector)
3. Land area consistency checks (FOLU sector)

Example QC Procedure

AG12

	A	B	C	D	E	F	AC	AD	AE	AF
1	**CO_2 EMISSIONS FROM CEMENT PRODUCTION**									
2			**1990**	**1991**	**1992**	**1993**	**2016**	**2017**	**2018**	**2019**
3	Clinker Production	(Thousand metric tons)	64,355	62,918	63,411	66,957	75,633	76,678	77,112	79,000
4	CO_2 Released	(Thousand metric tons)	32,828	32,095	32,346	34,155	38,581	39,114	39,335	40,298
5	CKD CO_2 Release*	(Thousand metric tons)	657	642	647	683	772	782	787	806
6	**Total CO_2 Release**	**(thousand metric tons CO_2 Eq.)**	33,484	32,736	32,993	34,838	39,352	39,896	40,122	41,10
7		**(million metric tons CO_2 Eq.)**	**33.5**	**32.7**	**33.0**	**34.8**	**39.4**	**39.9**	**40.1**	**41**
8										

Quality Control Procedure #1:

- Cross-check spreadsheet values to publication values
- Document implementation in checklist

CEMENT

(Data in thousand metric tons unless otherwise noted)

Domestic Production and Use: In 2020, U.S. portland cement production increased slightly to an estimated 87 million tons, and masonry cement production decreased slightly to 2.3 million tons. Cement was produced at 96 plants in 34 States, and at 2 plants in Puerto Rico. Texas, Missouri, California, and Florida were, in descending order of production, the four leading cement-producing States and accounted for nearly 45% of U.S. production. Overall, the U.S. cement industry's growth continued to be constrained by closed or idle plants, underutilized capacity at others, production disruptions from plant upgrades, and relatively inexpensive imports. In 2020, shipments of cement were essentially unchanged from those of 2019 and were valued at $12.7 billion. In 2020, it was estimated that 70% to 75% of sales were to ready-mixed concrete producers, 10% to concrete product manufacturers, 8% to 10% to contractors, and 5% to 12% to other customer types.

Salient Statistics—United States:[1]	**2016**	**2017**	**2018**	**2019**	**2020**[e]
Production:					
Portland and masonry cement[2]	84,695	86,356	86,368	[e]88,000	89,000
Clinker	75,633	76,678	77,112	79,000	79,000
Shipments to final customers, includes exports	95,397	97,935	99,419	103,000	103,000
Imports for consumption:					
Hydraulic cement	11,742	12,288	13,764	[illegible]	15,000
Clinker	1,496	1,209	967	1,160	1,400
Exports of hydraulic cement and clinker	1,097	1,035	919	1,002	1,000
Consumption, apparent[3]	95,150	97,160	98,500	[e]103,000	102,000
Price, average mill value, dollars per ton	111	117	121	[e]123	124
Stocks, cement, yearend	7,420	7,870	8,580	[e]7,140	7,800
Employment, mine and mill, number[e]	12,700	12,500	12,300	12,500	12,500
Net import reliance[4] as a percentage of apparent consumption	13	13	14	14	15

Recycling: Cement is not recycled, but significant quantities of concrete are recycled for use as a construction aggregate. Cement kilns can use waste fuels, recycled cement kiln dust, and recycled raw materials such as slags and fly ash. Various secondary materials can be incorporated as supplementary cementitious materials (SCMs) in blended cements and in the cement paste in concrete.

Example QC Procedure

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QC Procedure #2:

- Check that spreadsheets use consistent units and are properly labelled
- Document implementation in checklist

Where to Apply the QA/QC

General QC checks are applicable to **all inventory categories and all types of data**

Questions to consider for prioritizing your QC process:

1. Is the source/sink a Key Category?
2. Has a category's methodology or data changed?
3. Is there a high level of uncertainty for the category?
4. When was the last time this category went through the QC check?

Some categories need more QA/QC than others!

When to Apply the Quality Control

What level of quality control is needed annually?

- Appy general checks to a sample of data and calculations from each category each year
- Quality control (QC) should be performed prior to any peer review
- Apply if you update data prior to finalizing inventory

Some quality control is needed only periodically.

- Category-specific procedures may only be applied every other year, and can be prioritized for key categories
- Emission factors/activity data QC may only need to be implemented when there are changes (e.g., in activity, data sources, or science)

Quality Assurance Procedures

- Expert peer review (should)
  - Provide an objective review of methods, data and results and ensure it is reasonable/technically sound
  - Involve reviewers or experts not involved in preparing the inventory
  - Can focus on whole report and/or parts
    - ⑩ Prioritize key categories and areas with methodological refinements
- Audits
  - Provide an in-depth analysis of the procedures taken to develop an inventory, based on the documentation available

Quality Control – “Bottom Line”

1. Check your work i.e., implementing and documenting QA/QC steps assures inventory quality and builds confidence in national data
2. Start with general quality control (QC) checklist included in IPCC guidance
3. Identify areas for improvement (beyond identifying basic errors)
4. Develop a basic QC plan to check all estimates, and add additional checks prioritizing more significant categories (i.e., key categories)
    - Assign roles/responsibilities (e.g., a QA/QC coordinator to implement and maintain QA/QC plan)
    - Consider if you can include additional QC checks for Key Categories
    - Communicate plan and outputs to inventory compilation team
5. Establish a process and schedule for QA

Poll Questions - Mentimeter

Go to

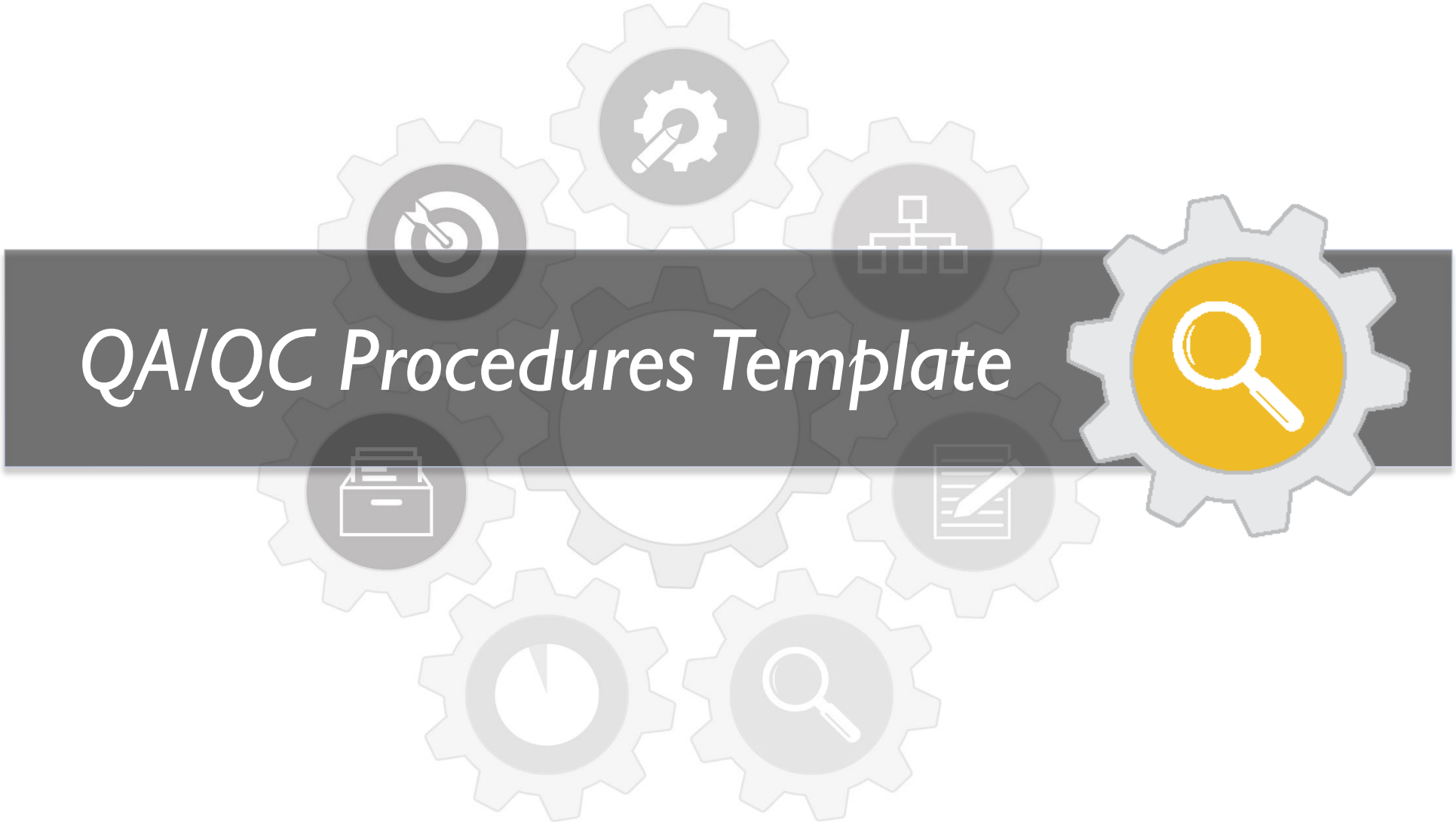
www.menti.com

Enter the code

8125 9360

Or use QR code

QA/QC Procedures Template



How This Template Will Help!

Resources in the QA/QC Template will help the inventory team:

- Define QA/QC roles and responsibilities
- Establish your official QA/QC timeline to build upon
- Establish general & category-specific QC procedures
- Establish QA procedures
- Document external reviewers
- Document improvements for the future

Step 1: Roles and Responsibilities

Table 4-1. Inventory Compilation Team Members Responsible for QA/QC Activities

Role	QA/QC Responsibility	Name	Organization	Contact Information
National Inventory Coordinator	• Coordinate with the QA/QC Coordinator on QA/QC plan implementation • Focus on cross-cutting QA/QC activities	[Enter Text]		
QA/QC Coordinator	• Develop and implement the overall QA/QC plan			
Sector or Category Lead(s)	• Develop and implement general, sector/category-specific (as appropriate) QA/QC procedures listed in Tables 4-3 and 4-4 below. • Focus on key categories			

Who completes this table: National Inventory Coordinator (NIC) and QA/QC Coordinator

Example of Table 4-1

Table 4-1. Inventory Compilation Team Members Responsible for QA/QC Activities

Role	QA/QC Responsibility	Name	Organization	Contact Information
National Inventory Coordinator	• Coordinate with the QA/QC Coordinator on QA/QC plan implementation • Focus on cross-cutting QA/QC activities	M. Desai	EPA	Email and Phone Number
QA/QC Coordinator	• Develop and implement the overall QA/QC plan	J. Steller	EPA	Email and Phone Number
Sector or Category Lead(s)	• Develop and implement general, sector/category-specific (as appropriate) QA/QC procedures listed in Tables 4-3 and 4-4 below. • Focus on key categories	A. Chiu	EPA - OAP	Email and Phone Number
		T. Wirth	EPA – OAP	Email and Phone Number
		S. Roberts	EPA – OTAQ	Email and Phone Number
		G. Domke	USFS	Email and Phone Number

Who completes this table: National Inventory Coordinator (NIC) and QA/QC Coordinator

Step 2: Document Existing QA/QC

Table 4-2. Documentation of Existing QA/QC Activities

QA/QC Documentation Questions	Sector/Category	Procedure	Supporting Documents
Are there existing QC procedures from previous compilation cycles?	[Enter text]		
Are there existing QA activities from previous compilation cycles?			
Are QA/QC findings from previous checks and reviews logged into an overall inventory improvement plan?			
Are there additional QA/QC activities and procedures that are documented elsewhere?			
Does the entity responsible for GHG inventory development have any data quality or quality assurance procedures that must be followed?			
Have data providers (e.g., government agencies, industry) undertaken data quality procedures before providing data for GHG inventory development?			

Who completes this table: National Inventory Coordinator (NIC) and QA/QC Coordinator

Example of Table 4-2

Table 4-2. Documentation of Existing QA/QC Activities

QA/QC Documentation Questions	Sector/Category	Procedure	Supporting Documents
Are there existing QC procedures from previous compilation cycles?	Livestock	Yes, a basic checklist exists.	Livestock QC.xlsx
Are there existing QA activities from previous compilation cycles?	Livestock	Yes, a basic expert peer review procedure is documented	QA Expert Review Steps.docx
Are QA/QC findings from previous checks and reviews logged into an overall inventory improvement plan?	Livestock	No, previous QA/QC activities were not sufficiently recorded.	N/A
Are there additional QA/QC activities and procedures that are documented elsewhere?	Livestock	No, currently no additional QA/QC activities are documented.	N/A
Does the entity responsible for GHG inventory development have any data quality or quality assurance procedures that must be followed?	Livestock	Yes, a series of rules have been established that must be followed.	Quality Assurance Project Plan.docx
Have data providers (e.g., government agencies, industry) undertaken data quality procedures before providing data for GHG inventory development?	Livestock	Yes, the underlying activity data are held to a statistical standard and documented in the individual reference reports.	Sheep and Lambs Annual Report.pdf

Who completes this table: National Inventory Coordinator (NIC) and QA/QC Coordinator

Step 3: Establish general QC procedures

Table 4-3. General QA/QC Procedures

Item	Procedure Completed		Corrective Measure (if applicable)			Supporting Documents
	Date	Name	Errors (Y/N)	Action Taken	Name, Date	
DATA GATHERING, INPUT, AND HANDLING CHECKS						
1. Check a sample of input for transcription errors. Use electronic data where possible to minimize transcription errors from manual data entry						
a. Check a sample of the input data from each category (e.g., activity data, emission factors, uncertainty inputs) for transcription errors.						
b. Ensure that all activity data and conversion factors are entered with the appropriate number of significant figures or to the exact value.						

Who completes this table: QA/QC Coordinator, with NIC and Sector/Category Leads

Example of Table 4-3

Table 4-3. General QA/QC Procedures

Item	Procedure Completed		Corrective Measure (if applicable)			Supporting Documents
	Date	Name	Errors (Y/N)	Action Taken	Name, Date	
DATA GATHERING, INPUT, AND HANDLING CHECKS						
1. Check a sample of input for transcription errors. Use electronic data where possible to minimize transcription errors from manual data entry						
a. Check a sample of the input data from each category (e.g., activity data, emission factors, uncertainty inputs) for transcription errors.	10/1/2023	A. Smith	N	10/1/2023	A. Smith	CementQA.xlsx
b. Ensure that all activity data and conversion factors are entered with the appropriate number of significant figures or to the exact value.	10/2/2023	A. Smith	Y	10/2/2023	A. Smith	Cement.xlsx

Who completes this table: QA/QC Coordinator, with NIC and Sector/Category Leads

Step 4: Category-Specific QC Activities

Table 4-4. Category-specific QC Procedures

Item	Procedure Completed		Corrective Measure Taken (if applicable)			Supporting Documents
	Date	Name (first initial, last name)	Errors (Y/N)	Date	Name (first initial, last name)	
EMISSION DATA QUALITY CHECKS						
1. Check EMISSIONS COMPARISONS: Historical data for categories and key subcategories.						
a. Compare emission estimates to results from previous inventories and review any unusual increases or decreases. Compare national-level estimates as well as category and subcategory estimates.	[Enter text]					
b. Check against independent estimates of emissions and/or removals based on alternative methods.						

Who completes this table: QA/QC Coordinator, with NIC and Sector/Category Leads

Example of Table 4-4

Table 4-4. Category-specific QC Procedures

Item	Procedure Completed		Corrective Measure Taken (if applicable)			Supporting Documents
	Date	Name (first initial, last name)	Errors (Y/N)	Date	Name (first initial, last name)	
EMISSION DATA QUALITY CHECKS						
1. Check EMISSIONS COMPARISONS: Historical data for categories and key subcategories.						
a. Compare emission estimates to results from previous inventories and review any unusual increases or decreases. Compare national-level estimates as well as category and subcategory estimates.	9/27/2023	A. Anderson	Y	9/27/2023	A. Anderson	QA.xslsx
b. Check against independent estimates of emissions and/or removals based on alternative methods.	9/27/2023	A. Anderson	N	9/27/2023	A. Anderson	QA.xlsx

Who completes this table: QA/QC Coordinator, with NIC and Sector/Category Leads

Step 5: Establish QA activities

Enter information into Table 4-5 for each category

Table 4-5. Comments from External Reviewers

Name	Organization	Area of Expertise	Sector/Category	Contact Information	Date Comments Received	Comment Summary

Who completes this table: Sector/Category Leads

Example of Table 4-5

Table 4-5. Comments from External Reviewers

Name	Organization	Area of Expertise	Sector/Category	Contact Information	Date Comments Received	Comment Summary
Jane Expert	Auto Corp	Mobile Sources		(111) 234-5678 jane@auto.com	3/18/22	A country specific emission factor is possible to calculate using…
John Expert	Univ. Of Place	Power plant models		(211) 234-5678 john@place.edu	3/18/22	The number of iterations in the model should be increased because…

Who completes this table: Sector/Category Leads

Expert Reviewers

- Ideally independent of the inventory agency
- Should be affiliated with other agencies, research facilities, international organizations, or others with relevant expertise
- Could also be affiliated with data supplying agencies/ organizations, national education institutions, or trade associations if applicable
- How to identify
  - Sector/Category Leads should provide recommendations
  - The QA/QC coordinator should maintain these recommendations and ask for updates at the beginning of each Inventory cycle

Step 6: Implement the QA/QC Plan

Table 4-6. Timeline of communication and implementation of the QA/QC plan

Activity	Timeline (When the activity will occur)	Outcome (Description of results of the activity)	Potential Improvements (How the activity may be modified to produce a better outcome)
Create or update the QA/QC plan			
Distribute the plan to each inventory compilation team member or external expert			
Engage with members of the inventory team and external experts to ensure procedures and purpose of the QA/QC plan is clear			

Example of Table 4-6

Table 4-6. Timeline of communication and implementation of the QA/QC plan

Activity	Timeline (When the activity will occur)	Outcome (Description of results of the activity)	Potential Improvements (How the activity may be modified to produce a better outcome)
Create or update the QA/QC plan	Update plan by June 30 each year	Updates to the QC Plan was implemented with the QC check outcomes from the previous Inventory. Categories to undergo additional QC checks have been identified for the 1990-2020 Inventory	In addition to the Expert Review and Public Review QA processes, a potential improvement is to conduct an internal peer review QC process by inventory team members to focus on consistency and clarify of inventory information
Distribute the plan to each inventory compilation team member or external expert	Identify by July 14		
Engage with members of the inventory team and external experts to ensure procedures and purpose of the QA/QC plan is clear	No later than July 31	Ideally determine any steps or actions that are unclear to inventory team so each member understands fully the purpose and role.	Update any steps that are unclear to inventory team

Step 7: Propose Improvements

Enter information into Table 4-7 for each category

Table 4-7. Potential Improvements to the GHG inventory

Topic	Category Code and Name	Issue	Improvement Option	Relevant Inventory Quality Principle
[Enter text]				

Who completes this table: Sector/Category Leads

Example of Table 4-7

Table 4-7. Potential Improvements to the GHG inventory

Topic	Category Code and Name	Issue	Improvement Option	Relevant Inventory Quality Principle
Equations	5.1 Enteric Fermentation	Implement year-specific milk fat values	Use Ministry of Agriculture reports to update milk fat percentage annually	Accuracy

Who completes this table: Sector/Category Leads

Additional Forms & Checklists

Checklists to track tasks may help the **QA/QC Coordinator** track progress of the development of the overall QA/QC plan, and QA/QC activities throughout the process, these include:

- QA/QC Coordinator Checklist
  - Developing, periodically reviewing, and updating the QA/QC plan
  - Managing and delivery documentation of QA/QC activities to the NIC and Archiving Coordinator (see Template 2. Institutional Arrangements)

Activities	Procedure Completed	
	Name	Date
1. Communicate and clarify QA/QC responsibilities to inventory team members.	B. Wilson	9/30/2023

Additional Forms & Checklists, continued

- National Inventory Coordinator (NIC) Checklist: Cross-Cutting Checks for Overall Inventory Quality
  - Check t hat calculations using the same data inputs (e.g., animal population data) report comparable values and units (e.g., magnitude)
  - Ensure that trends are explained, especially when there is a departure from expected trends
- National Inventory Coordinator (NIC) Checklist: Detailed Checklist for National Inventory Document (NID)
  - Ensuring the correct year and current trends discussion are included
  - Checking that table formatting is consistent across NID

Expert Review Elicitation Template

- The suggested text walks through examples of a memorandum including:
  - Subject Line
  - Introduction
  - Categories to be reviewed
  - Relevant updates
    - Meaning the categories where methodological updates have been applied, summarize the updates
  - General Questions
  - Sector/Category-specific Questions
  - Submitting feedback
    - Instruct the reviewer how and when you would like the feedback to be returned, as well as a contact in case they have questions

Action Items for QA/QC Procedures

1. Assign specific QA/QC responsibilities
2. Develop your QA/QC Plan, and include budget information
3. Communicate QA/QC Plan with the whole inventory compilation team
    1. The National Inventory Inception Memorandum Template is an effective way to document and communicate the QA/QC plan
4. Establish a process and schedule for the QA review
5. Identify potential improvements to QA/QC during the process
    - This will make the National Inventory Improvement Plan (Template 7) easier to complete

Make sure the whole inventory team understand the inventory QA/QC plan and know what their roles and responsibilities are

Other Resources

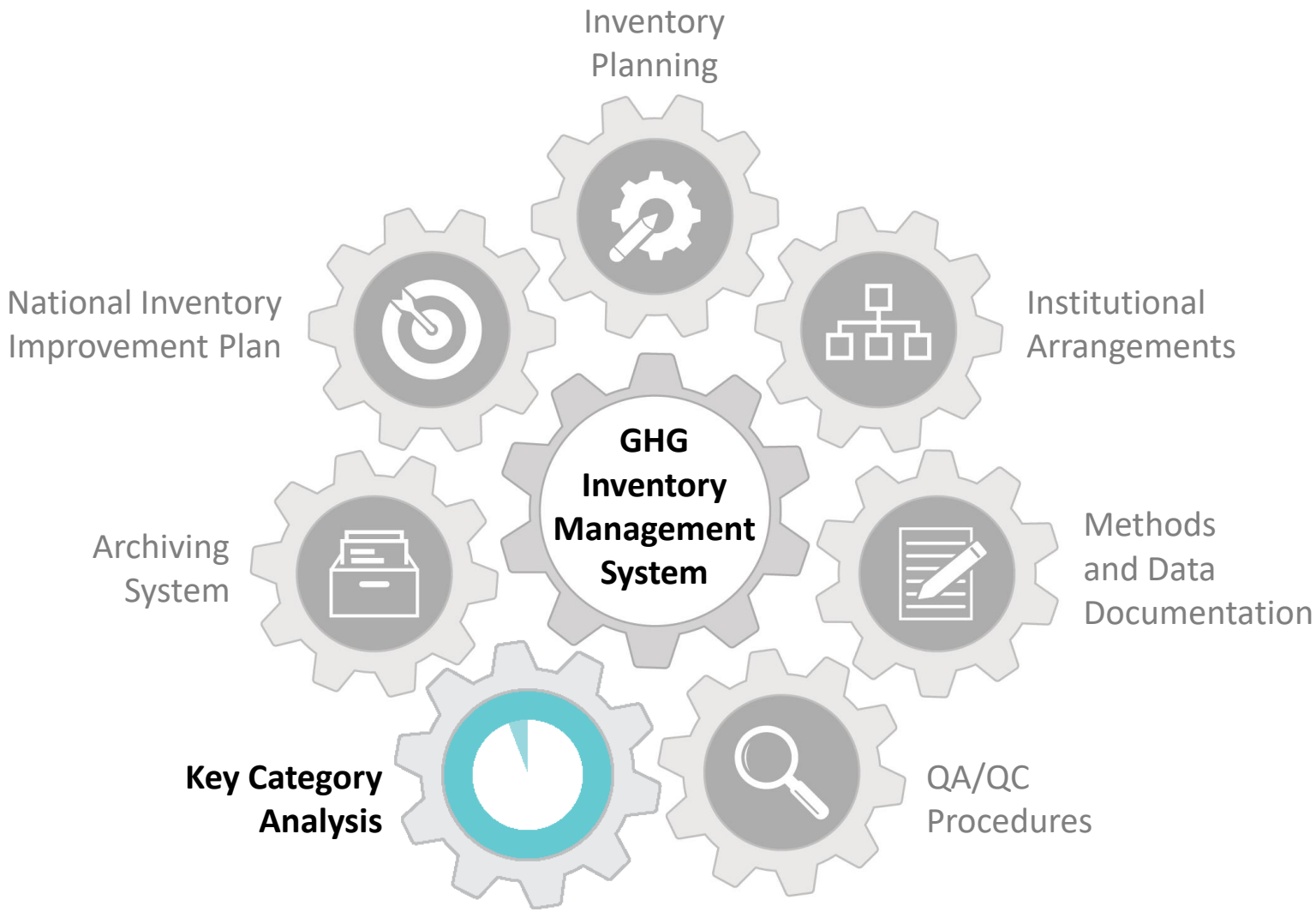
- The *Managing National GHG Inventory Process* handbook is a good source:
  - Pages 27-28: QC Procedures
  - Page 47-48: Can ask peer review questions of own inventory
- Handbook on Measurement, Reporting and Verification For Developing Country Parties
- Guide For Peer Review of National GHG Inventories

Next template…

Questions?

INTERMISSION

Key Category Analysis



Poll Questions - Mentimeter

Go to

www.menti.com

Enter the code

8125 9360

Or use QR code

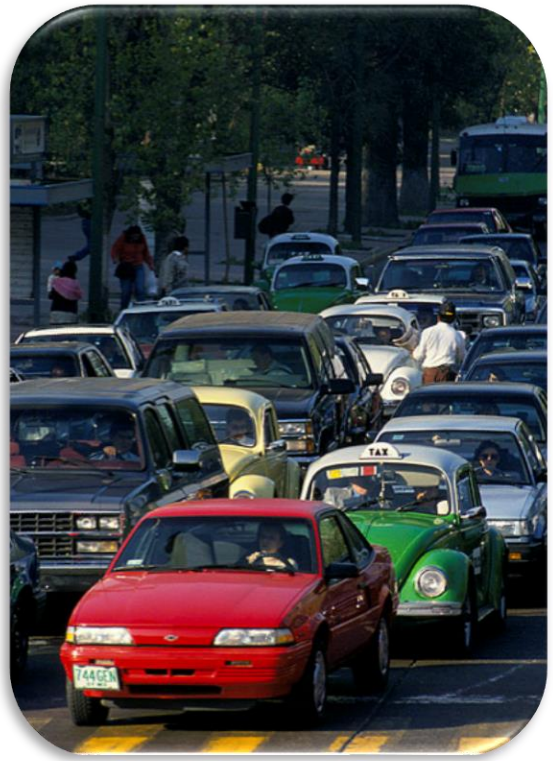
What is a Key Category?

2006 IPCC Volume 1, Chapter 4

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.**

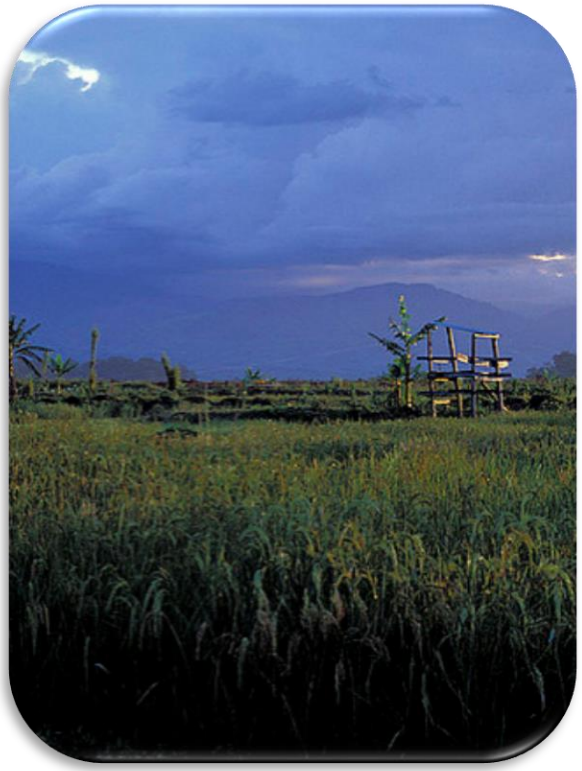
Example Key Source and Sink Categories

Absolute level contribution to total emissions



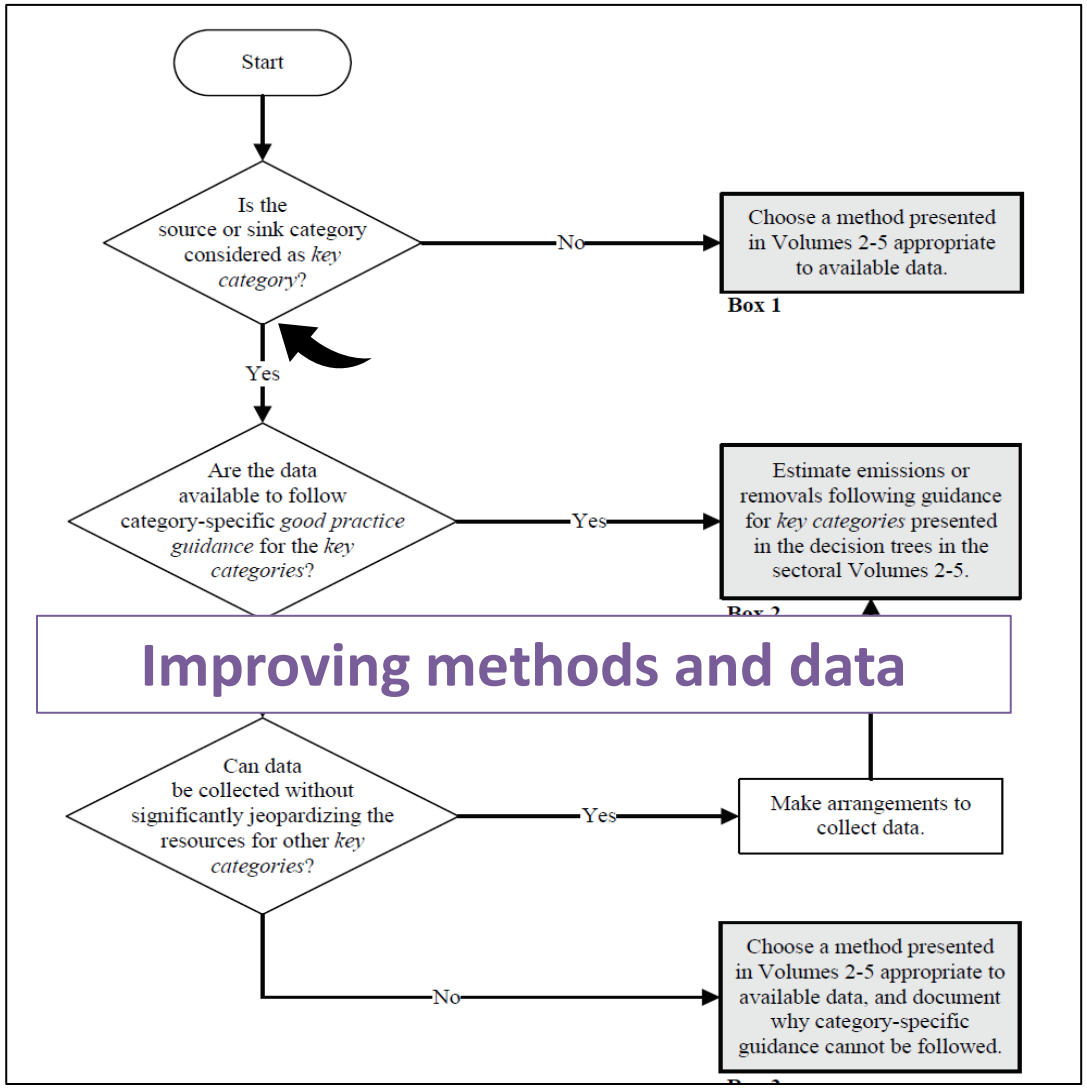
Trend: High growth rate in emissions

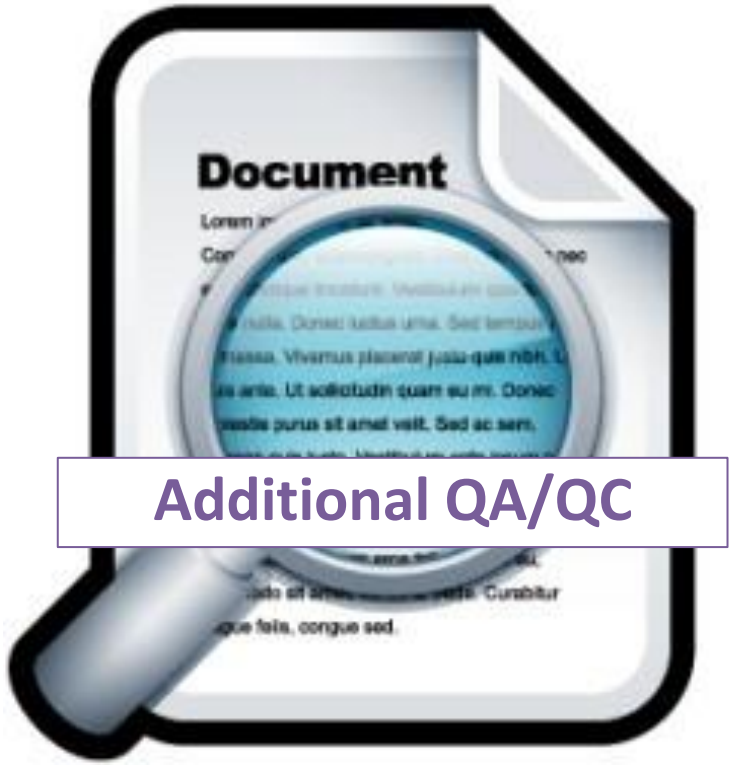
Uncertainty in emissions or removals



Prioritizing Key Categories in National GHG Inventories

Figure 4.1 Decision Tree to choose a Good Practice method





How to Identify Key Categories

Quantitative Approaches

Qualitative Approaches

How to Identify Key Categories

Quantitative Approaches

- Use emission and sink estimates and uncertainty analysis results to analyze actual category contribution to both overall emissions and sinks and uncertainty.

Qualitative Approaches

How to Identify Key Categories

Quantitative Approaches	Qualitative Approaches
• Use emission and sink estimates and uncertainty analysis results to analyze actual category contribution to both overall emissions and sinks and uncertainty.	• Completeness: If there are known categories that are excluded from the inventory, consider qualitive criteria to identify any additional key categories. • Other qualitative criteria include expected growth, lack of quantified uncertainty assessment, and mitigation effects

Quantitative Assessment for Identifying Key Categories

- ✓ **Approach 1** sorts and ranks source and sink categories according to their absolute contribution to total emissions and removals and identifies categories that collectively contribute **95%** of total national emissions and removals
  - ✓ A "level assessment" looks at a particular year
  - ✓ A "trend assessment" looks at the category trend relative to national trend in emissions and removals
- ✓ **Approach 2** is similar, but sorts and ranks category estimates according to their absolute contribution weighted by **uncertainty,** and identifies categories that collectively contribute **90%** of uncertainty weighted total national emissions and removals

Note: If using the IPCC Inventory Software, quantitative KCA is performed automatically by the software as data is entered – no need to process separately. Future reporting tools will also automate implementation of Approach 1 for identifying key categories.

Quantitative Assessment: Conducting an Approach 1 Level Assessment

Before you get started:

1. Identify roles - Decide who will conduct the KCA (e.g., National Inventory Coordinator).

2. Organize your inventory estimates in at disaggregation levels consistent with IPCC guidance: estimates are organized by the categories, subcategories where applicable, and gases as outlined in the 2006 IPCC Guidelines, Volume 1, Chapter 4, Table 4.1.

→ *Perform analysis including and excluding LULUCF sector*

2006 IPCC Equation for a Level Assessment (Approach 1)

Equation 4.1 Level Assessment (Approach 1)

$$L_{x,t} = \left|E_{x,t}\right| \Big/ \sum_{y} \left|E_{y,t}\right|$$

Where,

$L_{x,t}$ = Level assessment of source or sink category *x* in latest inventory year (year *t*)

$\left|E_{x,t}\right|$ = absolute value of emission or removal estimate of source or sink category *x* in year *t*

$\sum_{y} \left|E_{y,t}\right|$ = total contribution, which is the sum of the absolute values of emissions and removals in year t calculated using the aggregation level chosen by the country for key category analysis.

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 1) List all inventory categories for year of level analysis (e.g., latest reported year)

Emission Category	Gas	Gg CO_2 eq.

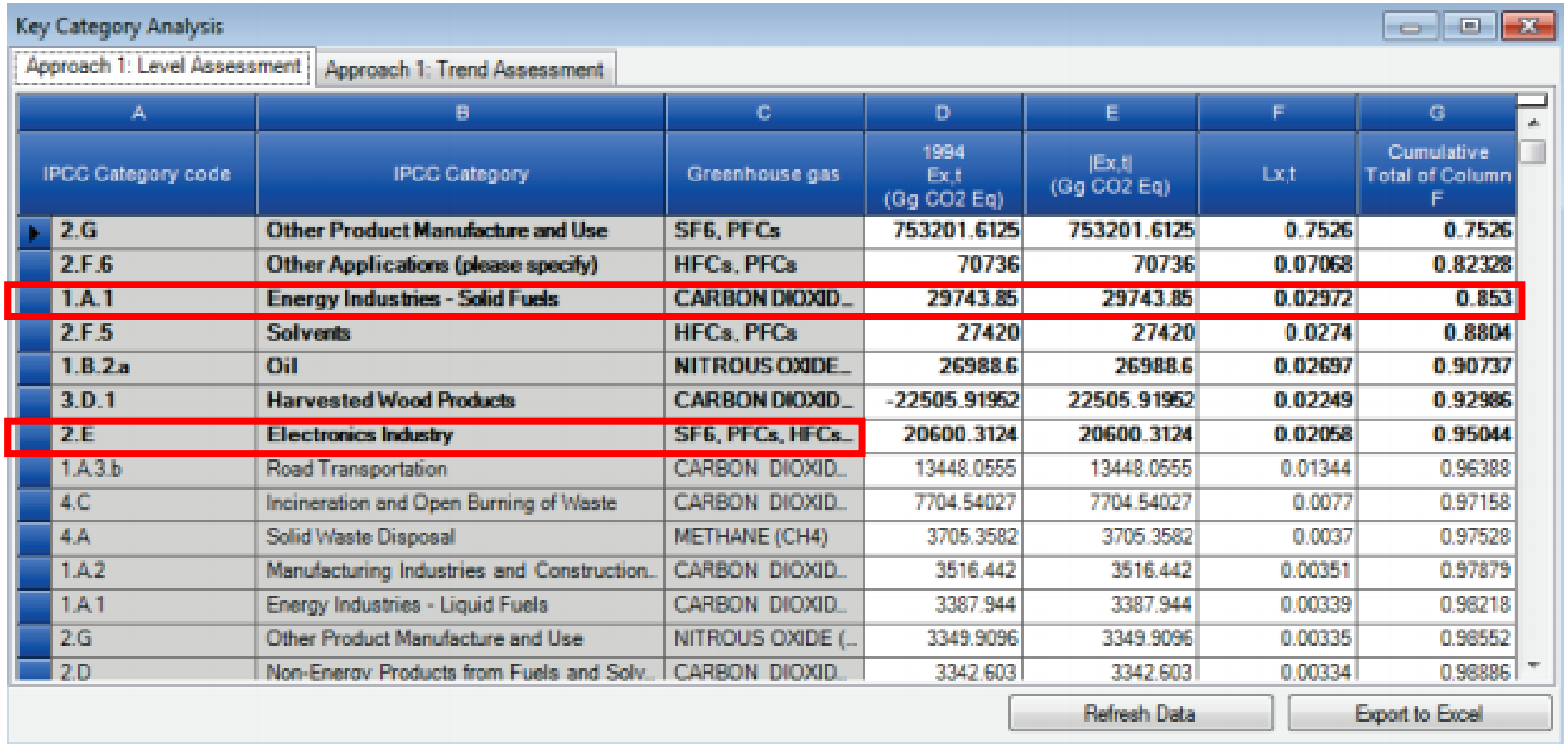
Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 1) List all inventory categories for year of level analysis (e.g., latest reported year)

Emission Category	Gas	Gg CO_2 eq.
Energy Industries (solid fuel)	CO_2	300
Road Transportation	CO_2	110
Iron and Steel Production	CO_2	90
Iron and Steel Production	CH_4	1
Forest Land Remaining Forest Land	CO_2	-190
Croplands Remaining Croplands	CO_2	6
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4
Enteric Fermentation	CH_4	100
Manure Management	N_2O	80
Cement Production	CO_2	30
Rice Cultivation	CH_4	50

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Important good practice: The analysis should be performed at appropriate level of aggregation (i.e., at level at which you estimate IPCC categories or subcategories, per methods and decision trees).



A	B	C	D	E	F	G
IPCC Category code	IPCC Category	Greenhouse gas	1994 Ex,t (Gg CO2 Eq)	|Ex,t| (Gg CO2 Eq)	Lx,t	Cumulative Total of Column F
2.G	Other Product Manufacture and Use	SF6, PFCs	753201.6125	753201.6125	0.7526	0.7526
2.F.6	Other Applications (please specify)	HFCs, PFCs	70736	70736	0.07068	0.82328
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXID...	29743.85	29743.85	0.02972	0.853
2.F.5	Solvents	HFCs, PFCs	27420	27420	0.0274	0.8804
1.B.2.a	Oil	NITROUS OXIDE...	26988.6	26988.6	0.02697	0.90737
3.D.1	Harvested Wood Products	CARBON DIOXID...	-22505.91952	22505.91952	0.02249	0.92986
2.E	Electronics Industry	SF6, PFCs, HFCs...	20600.3124	20600.3124	0.02058	0.95044
1.A.3.b	Road Transportation	CARBON DIOXID...	13448.0555	13448.0555	0.01344	0.96388
4.C	Incineration and Open Burning of Waste	CARBON DIOXID...	7704.54027	7704.54027	0.0077	0.97158
4.A	Solid Waste Disposal	METHANE (CH4)	3705.3582	3705.3582	0.0037	0.97528
1.A.2	Manufacturing Industries and Construction...	CARBON DIOXID...	3516.442	3516.442	0.00351	0.97879
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXID...	3387.944	3387.944	0.00339	0.98218
2.G	Other Product Manufacture and Use	NITROUS OXIDE (...	3349.9096	3349.9096	0.00335	0.98552
2.D	Non-Energy Products from Fuels and Solv...	CARBON DIOXID...	3342.603	3342.603	0.00334	0.98886

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 2) Sort in descending order by contribution to total emissions (absolute values)

Emission Category	Gas	Gg CO_2 eq.	Cumulative %
Energy Industries (solid fuel)	CO_2	300	
Forest Land Remaining Forest Land	CO_2	**190**	
Road Transport	CO_2	110	
Enteric Fermentation	CH_4	100	
Iron and Steel Production	CO_2	90	
Manure Management	N_2O	80	
Rice Cultivation	CH_4	50	
Cement Production	CO_2	30	
Croplands Remaining Croplands	CO_2	6	
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	
Iron and Steel Production	CH_4	1	

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 3) Sum cumulative contribution of sources and sinks in absolute, descending order until you reach 95%

Emission Category	Gas	Gg CO_2 eq.	Cumulative %
Energy Industries (solid fuel)	CO_2	300	
Forest Land Remaining Forest Land	CO_2	190	
Road Transport	CO_2	110	
Enteric Fermentation	CH_4	100	
Iron and Steel Production	CO_2	90	
Manure Management	N_2O	80	
Rice Cultivation	CH_4	50	
Cement Production	CO_2	30	
Croplands Remaining Croplands	CO_2	6	
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	
Iron and Steel Production	CH_4	1	

TOTAL : 961

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 3) Sum cumulative contribution of sources and sinks in absolute, descending order until you reach 95%

Emission Category	Gas	Gg CO_2 eq.	Cumulative %
Energy Industries (solid fuel)	CO_2	300	= 300/961 × 100% =31%
Forest Land Remaining Forest Land	CO_2	190	
Road Transport	CO_2	110	
Enteric Fermentation	CH_4	100	
Iron and Steel Production	CO_2	90	
Manure Management	N_2O	80	
Rice Cultivation	CH_4	50	
Cement Production	CO_2	30	
Croplands Remaining Croplands	CO_2	6	
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	
Iron and Steel Production	CH_4	1	

TOTAL : 961

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 3) Sum cumulative contribution of sources and sinks in absolute, descending order until you reach 95%

Emission Category	Gas	Gg CO_2 eq.	Cumulative %
Energy Industries (solid fuel)	CO_2	300	31%
Forest Land Remaining Forest Land	CO_2	190	= [(190/961)*100] **+ 31%**
Road Transport	CO_2	110	
Enteric Fermentation	CH_4	100	
Iron and Steel Production	CO_2	90	
Manure Management	N_2O	80	
Rice Cultivation	CH_4	50	
Cement Production	CO_2	30	
Croplands Remaining Croplands	CO_2	6	
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	
Iron and Steel Production	CH_4	1	

= 20% + 31% = 51%

TOTAL : 961

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 3) Sum cumulative contribution of sources and sinks in absolute, descending order until you reach 95%

Emission Category	Gas	Gg CO_2 eq.	Cumulative %
Energy Industries (solid fuel)	CO_2	300	31%
Forest Land Remaining Forest Land	CO_2	190	51%
Road Transport	CO_2	110	62%
Enteric Fermentation	CH_4	100	73%
Iron and Steel Production	CO_2	90	82%
Manure Management	N_2O	80	91%
Rice Cultivation	CH_4	50	96%
Cement Production	CO_2	30	99%
Croplands Remaining Croplands	CO_2	6	99%
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	99.9%
Iron and Steel Production	CH_4	1	100%

Sum to 95%

These are key categories identified by the approach 1 level assessment (including LULUCF) for the latest reported year

Quantitative Assessment: Conducting an Approach 1 Level Assessment

Step 3) Sum cumulative contribution of sources and sinks in absolute, descending order until you reach 95%

Emission Category	Gas	Gg CO_2 eq.	Cumulative %
Energy Industries (solid fuel)	CO_2	300	31%
Forest Land Remaining Forest Land	CO_2	190	51%
Road Transport	CO_2	110	62%
Enteric Fermentation	CH_4	100	73%
Iron and Steel Production	CO_2	90	82%
Manure Management	N_2O	80	91%
Rice Cultivation	CH_4	50	96%
Cement Production	CO_2	30	99%
Croplands Remaining Croplands	CO_2	6	99%
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	99.9%
Iron and Steel Production	CH_4	1	100%

Sum to 95%

Quantitative Assessment: Conducting an Approach 1 Level Assessment (w/LULUCF)

Step 3) Sum cumulative contribution of sources and sinks in absolute, descending order until you reach 95%

Emission Category	Gas	Gg CO_2 eq.	Cumulative %
Energy Industries (solid fuel)	CO_2	300	31%
Forest Land Remaining Forest Land	CO_2	190	51%
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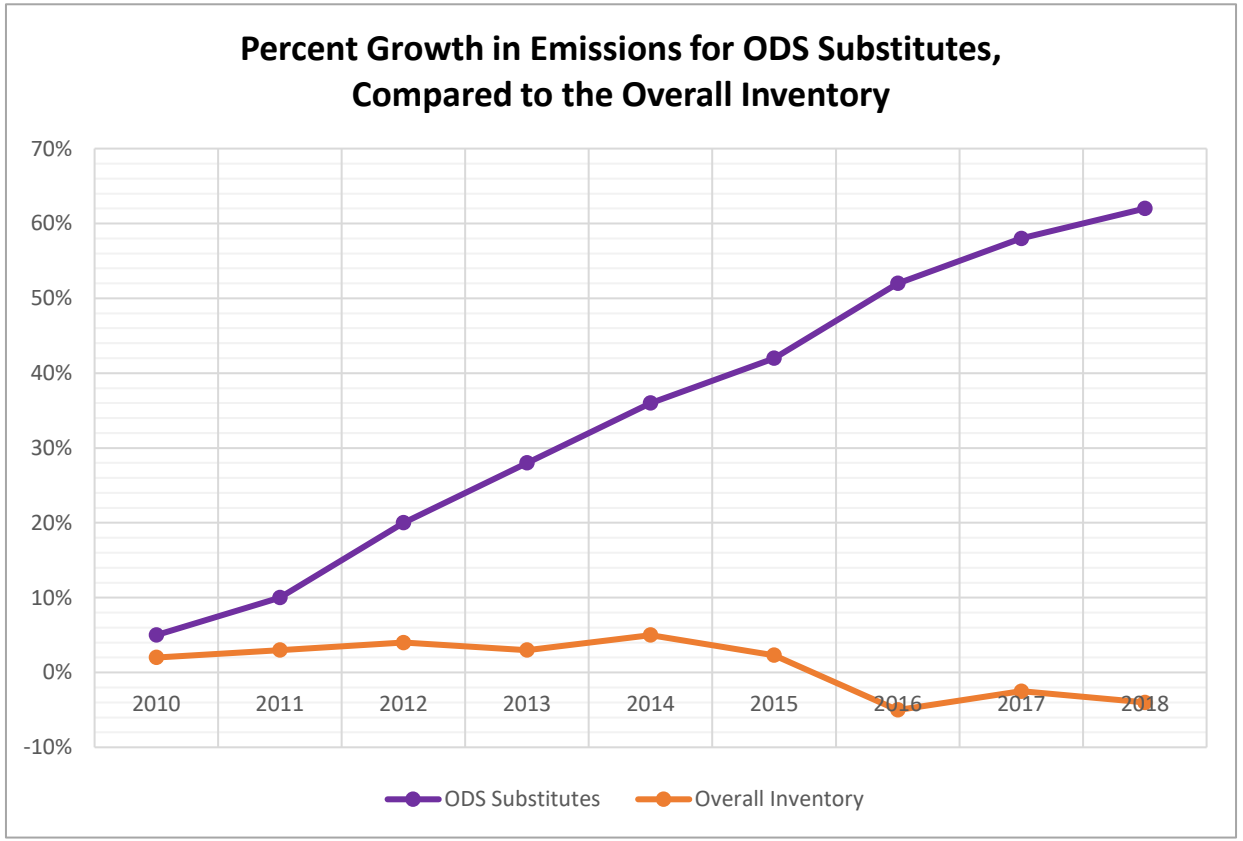
Cement Production	CO_2	30	99%
Croplands Remaining Croplands	CO_2	6	99%
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	99.9%
Iron and Steel Production	CH_4	1	100%

ETF reporting guidelines provide flexibility for developing countries, in light of their capacities, to instead use a threshold of no lower than 85% to allow focus on improving fewer categories

Quantitative Assessment: Trend Assessment



A trend assessment looks at a category's relative changes in emissions over time, instead of the contribution of a category to the total emission estimates for a country in a particular year (2006 IPCC GL).

2006 IPCC Equation for a Trend Assessment (Approach 1)

Equation 4.2 Trend Assessment (Approach 1)

$$T_{x,t} = \frac{|E_{x,0}|}{\sum_y |E_{y,0}|} \bullet \left| \left[\frac{(E_{x,t} - E_{x,0})}{|E_{x,0}|} \right] - \frac{\left(\sum_y E_{y,t} - \sum_y E_{y,0} \right)}{\left| \sum_y E_{y,0} \right|} \right|$$

Where,

$T_{x,t}$ = trend assessment of source or sink category *x* in year *t* as compared to the base year (year 0)

$|E_{x,0}|$ = absolute value of emission or removal estimate of source or sink category *x* in year 0

$E_{x,t}$ *and* $E_{x,0}$ = real values of estimates of source or sink category *x* in years *t* and 0, respectively

$\sum_y E_{y,t}$ *and* $\sum_y E_{y,0}$ = total inventory estimates in years *t* and 0, respectively

Note if base year = zero, activity was not occurring than use equation 4.3 to calculate trend assessment

EQUATION 4.3
TREND ASSESSMENT WITH ZERO BASE YEAR EMISSIONS

$$T_{x,t} = \left| E_{x,t} / \sum_y | E_{y,0} | \right|$$

2019 Refinement Equation for Trend Assessment (Approach 1) Updated/Simplified

Improved approach to identifying categories whose trend contributes to the trend of the overall inventory, which may not be captured by level assessment.

EQUATION 4.2 (UPDATED)
TREND ASSESSMENT (APPROACH 1)

$$T_{x,t} = \left| \frac{E_{x,t} - E_{x,0}}{\sum_i E_{i,t} - \sum_i E_{i,0}} \right|$$

Where:

$T_{x,t}$ = trend assessment of source or sink category x in year t as compared to the base year (year 0)

$E_{x,0}$ and $E_{x,t}$ = value of emission or removal estimate of source or sink category x in year 0 and year t

$\sum_i E_{i,t}$ and $\sum_i E_{i,0}$ = total inventory estimates in years t and 0, respectively

for i = 1, ..., n

Quantitative Assessment: Conducting an Approach 1 Trend Assessment (w/LULUCF)

Emission Category	Gas	1990 Gg CO_2 eq.	2018 Gg CO_2 eq.	Trend Assessment	% Contribution to Trend	Cumulative Total
Energy Industries (solid fuel)	CO_2	200	300	=		
Forest Land Remaining Forest Land	CO_2	-210	-190			
Road Transport	CO_2	60	110			
Enteric Fermentation	CH_4	80	100			
Iron and Steel Production	CO_2	120	90			
Manure Management	CO_2	70	80			
Rice Cultivation	CH_4	45	50			
Cement Production	CO_2	35	30			
Croplands Remaining Croplands	N_2O	8	6			
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	1	4			
Iron and Steel Production	CH_4	1.5	1			
		TOTAL: 410.5	**TOTAL: 581**			

Per 2006 IPCC GL This is calculated as the difference between the trend of each category (the change in category between the base and current year) and trend of the total inventory (the change in total inventory emissions over time), weighted by the relative contribution of this category to absolute total emissions in the base year (level assessment in base year).

Quantitative Assessment: Conducting an Approach 1 Trend Assessment (w/LULUCF)

Emission Category	Gas	1990 Gg CO_2 eq.	2018 Gg CO_2 eq.	Trend Assessment	% Contribution to Trend	Cumulative Total
Energy Industries (solid fuel)	CO_2	200	300	0.02		
Forest Land Remaining Forest Land	CO_2	-210	-190	0.08		
Road Transport	CO_2	60	110	0.03		
Enteric Fermentation	CH_4	80	100	0.02		
Iron and Steel Production	CO_2	120	90	0.1		
Manure Management	CO_2	70	80	0.02		
Rice Cultivation	CH_4	45	50	0.02		
Cement Production	CO_2	35	30	0.02		
Croplands Remaining Croplands	N_2O	8	6	0.01		
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	1	4	0.00		
Iron and Steel Production	CH_4	1.5	1	0.00		
				TOTAL: 0.32		

Follow equations in 2006 IPCC GLs, Volume 1, Chapter 4 to calculate Trend Assessment

Quantitative Assessment: Conducting an Approach 1 Trend Assessment (w/LULUCF)

Emission Category	Gas	1990 Gg CO_2 eq.	2018 Gg CO_2 eq.	Trend Assessment	% Contribution to Trend	Cumulative Total
Energy Industries (solid fuel)	CO_2	200	300	0.02	6%	
Forest Land Remaining Forest Land	CO_2	-210	-190	0.08	25%	
Road Transport	CO_2	60	110	0.03	10%	
Enteric Fermentation	CH_4	80	100	0.02	5%	
Iron and Steel Production	CO_2	120	90	0.1	30%	
Manure Management	CO_2	70	80	0.02	7%	
Rice Cultivation	CH_4	45	50	0.02	5%	
Cement Production	CO_2	35	30	0.02	7%	
Croplands Remaining Croplands	N_2O	8	6	0.01	2%	
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	1	4	0.00	1%	
Iron and Steel Production	CH_4	1.5	1	0.00	0%	
				TOTAL: 0.32		

Follow equations in 2006 IPCC GLs, Volume 1, Chapter 4 to calculate Trend Assessment

Quantitative Assessment: Conducting an Approach 1 Trend Assessment

Emission Category	Gas	1990 Gg CO_2 eq.	2018 Gg CO_2 eq.	Trend Assessment	% Contribution to Trend	Cumulative Total
Iron and Steel Production	CO_2	120	90	0.02	30%	30%
Forest Land Remaining Forest Land	CO_2	-210	-190	0.08	25%	56%
Road Transport	CO_2	60	110	0.03	10%	65%
Cement Production	CO_2	35	30	0.02	7%	73%
Manure Management	CO_2	70	80	0.1	7%	80%
Energy Industries (solid fuel)	CO_2	200	300	0.02	6%	86%
Rice Cultivation	CH_4	45	50	0.02	5%	92%
Enteric Fermentation	CH_4	80	100	0.02	5%	97%
Croplands Remaining Croplands	N_2O	8	6	0.01	2%	99%
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	1	4	0.00	1%	
Iron and Steel Production	CH_4	1.5	1	0.00	0%	

Sum to 95%

TOTAL: 0.32

Follow equations in 2006 IPCC GLs, Volume 1, Chapter 4 to calculate Trend Assessment

2006 IPCC Equation for a Level orTrend Assessment (Approach 2)

EQUATION 4.4
LEVEL ASSESSMENT (APPROACH 2)

$$LU_{x,t} = \left(L_{x,t} \bullet U_{x,t} \right) / \sum_{y} \left[\left(L_{y,t} \bullet U_{y,t} \right) \right]$$

Where:

$LU_{x,t}$	=	level assessment for category x in latest inventory year (year t) with uncertainty
$L_{x,t}$	=	computed as in Equation 4.1
$U_{x,t}$	=	category percentage uncertainty in year t

EQUATION 4.5
TREND ASSESSMENT (APPROACH 2)

$$TU_{x,t} = \left(T_{x,t} \bullet U_{x,t} \right)$$

Where:

$TU_{x,t}$	=	trend assessment for category x in latest inventory year (year t) with uncertainty
$T_{x,t}$	=	trend assessment computed as in Equation 4.2
$U_{x,t}$	=	category percentage uncertainty in year t

Quantitative Assessment: Considering Uncertainty when Conducting an Approach 2 Trend Assessment

Emission Category	Gas	1990 Gg CO_2 eq.	2018 Gg CO_2 eq.	Trend Assessment	Trend Assessment Including Uncertainty	% Contribution to Trend	Cumulative Total
Energy Industries (solid fuel)	CO_2	200	300	0.02	=0.02*$U_{x,2018}$		
Forest Land Remaining Forest Land	CO_2	-210	-190	0.08			
Road Transport	CO_2	60	110	0.03			
Enteric Fermentation	CH_4	80	100	0.02			
Iron and Steel Production	CO_2	120	90	0.1			
Manure Management	CO_2	70	80	0.02			
Rice Cultivation	CH_4	45	50	0.02			
Cement Production	CO_2	35	30	0.02			
Croplands Remaining Croplands	N_2O	8	6	0.01			
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	1	4	0.00			
Iron and Steel Production	CH_4	1.5	1	0.00	**TOTAL: TBD**		

Qualitative Assessments to Conducting Key Category Analysis

- Mitigation techniques and technologies applied
- Expected emission growth
- Uncertainties not yet quantified, but presumed high (e.g., LULUCF)
- Not yet included in inventory (i.e., completeness)

Recap: Why Do a Key Category Analysis?

Perform Key Category Analysis

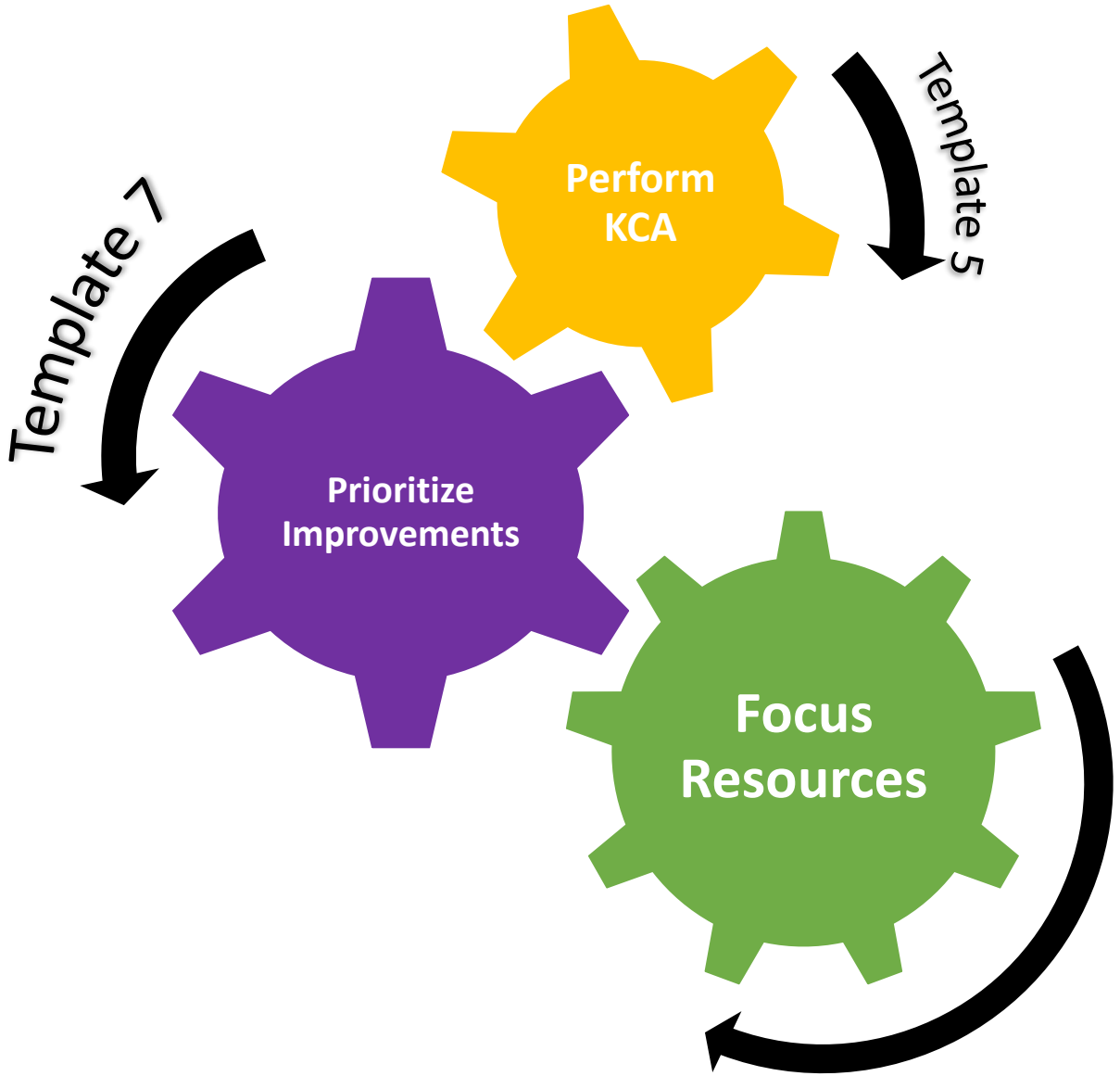
↓

Identify categories to prioritize in inventory planning and National GHG inventory improvement plan

↓

Focus Improvement Efforts on Key Categories

- Choose higher-tiered methods (Tier 2, 3)
- Obtain improved activity data
- Improve/establish institutional arrangements
- Focus QA/QC, etc.



Key Categories in the National Inventory Compilation Cycle

- Save all compilation files and references to create an inventory archive
- Backup the archive

- Inventory inception meeting
- Start with previous inventory, if available
- Review and implement improvement plan
- Identify Activity Data and choose methodologies

- Finalize inventory report, including reporting tables
- Develop improvement plan
- Publish/submit inventory for UNFCCC reporting on time

- Collect Activity Data, Emission Factors
- QC all data

- Conduct & document QA/QC procedures, such as basic peer review
- Address QA/QC findings

- Estimate emissions & removals
- Implement QC procedures
- Revise estimates, based on new data and QA/QC findings
- Ensure time series consistency
- Conduct uncertainty & key category analyses

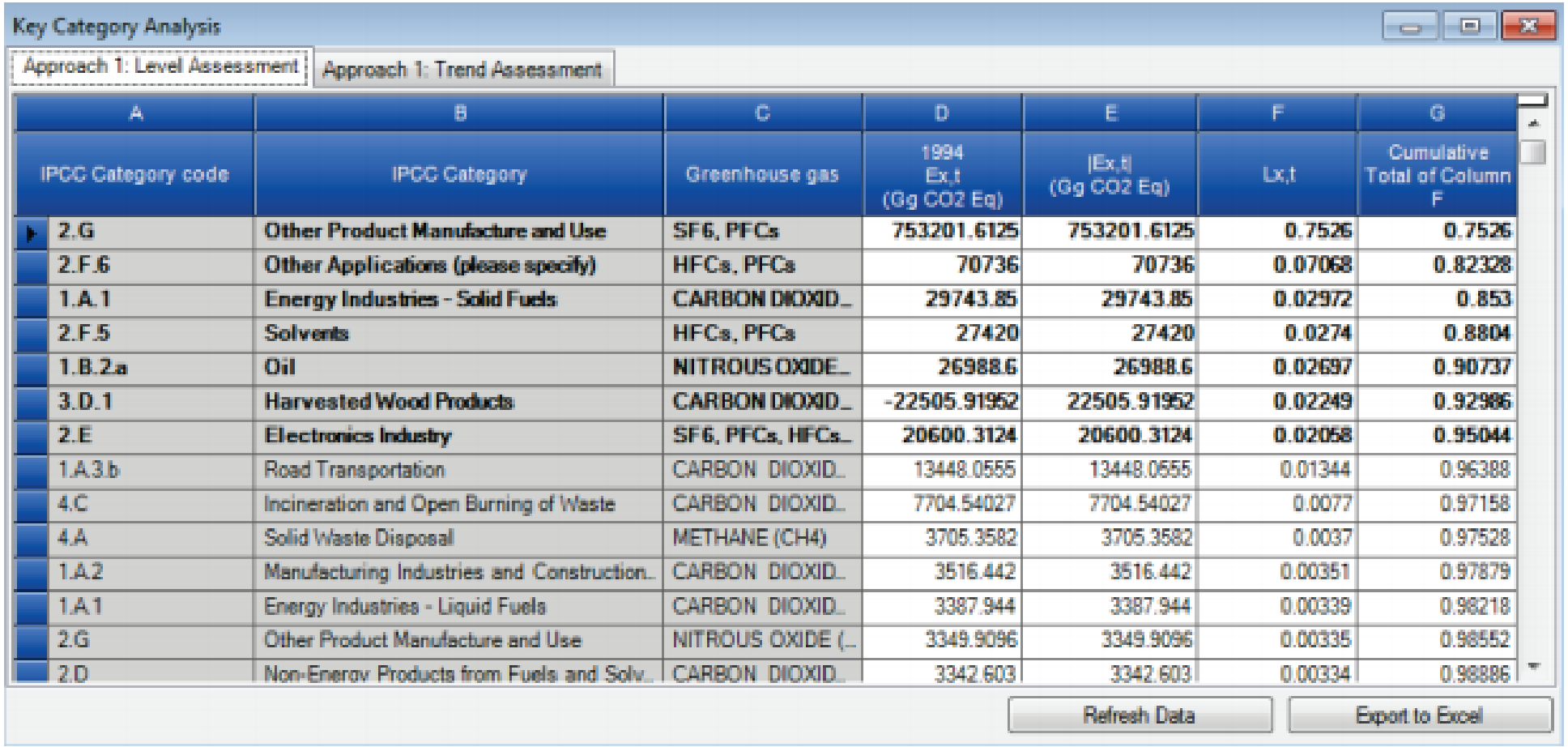
- Document methodological approaches, recalculations, and references
- Write inventory report, prepare draft reporting tables

Which tools for the KCA ?

- ✓ **National calculation file :** self implementation of the on IPCC equations
- ✓ **IPCC Software :** automates the KCA by implementing the IPCC equations
- ✓ **ETF / GHG Inventory Reporting tool** : generation of the Common Reporting Table 7 - SUMMARY OVERVIEW FOR KEY CATEGORIES (Level, Trend, including and excluding LULUCF ; using the reporting default category disaggregation levels)
- ✓ **EPA key category tool** : spreadsheet tool (Excel) to help inventory teams conduct a KCA, especially when not using the IPCC Software for the inventory

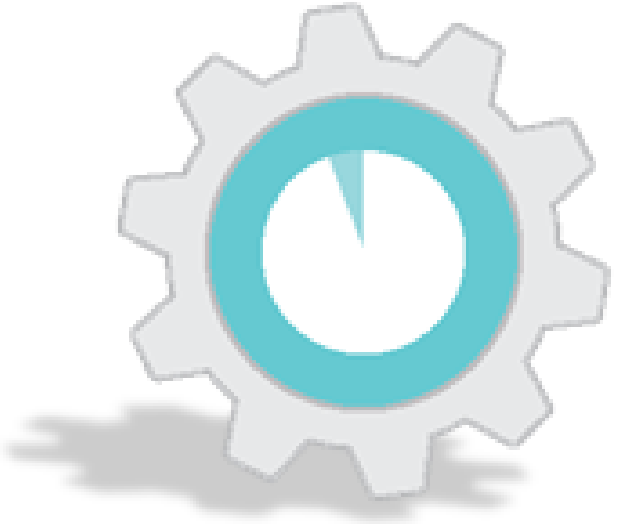
IPCC Inventory Software

Automates preparing a quantitative KCA analysis



A	B	C	D	E	F	G
IPCC Category code	IPCC Category	Greenhouse gas	1994 Ex,t (Gg CO2 Eq)	|Ex,t| (Gg CO2 Eq)	Lx,t	Cumulative Total of Column F
2.G	Other Product Manufacture and Use	SF6, PFCs	753201.6125	753201.6125	0.7526	0.7526
2.F.6	Other Applications (please specify)	HFCs, PFCs	70736	70736	0.07068	0.82328
1.A.1	Energy Industries - Solid Fuels	CARBON DIOXID...	29743.85	29743.85	0.02972	0.853
2.F.5	Solvents	HFCs, PFCs	27420	27420	0.0274	0.8804
1.B.2.a	Oil	NITROUS OXIDE...	26988.6	26988.6	0.02697	0.90737
3.D.1	Harvested Wood Products	CARBON DIOXID...	-22505.91952	22505.91952	0.02249	0.92986
2.E	Electronics Industry	SF6, PFCs, HFCs...	20600.3124	20600.3124	0.02058	0.95044
1.A.3.b	Road Transportation	CARBON DIOXID...	13448.0555	13448.0555	0.01344	0.96388
4.C	Incineration and Open Burning of Waste	CARBON DIOXID...	7704.54027	7704.54027	0.0077	0.97158
4.A	Solid Waste Disposal	METHANE (CH4)	3705.3582	3705.3582	0.0037	0.97528
1.A.2	Manufacturing Industries and Construction...	CARBON DIOXID...	3516.442	3516.442	0.00351	0.97879
1.A.1	Energy Industries - Liquid Fuels	CARBON DIOXID...	3387.944	3387.944	0.00339	0.98218
2.G	Other Product Manufacture and Use	NITROUS OXIDE (...	3349.9096	3349.9096	0.00335	0.98552
2.D	Non-Energy Products from Fuels and Solv...	CARBON DIOXID...	3342.603	3342.603	0.00334	0.98886

EPA Key Category Analysis



National System Templates

Template 5: Key Category Analysis

Key Category Tool

Helps implement IPCC methods, and calculate Key Categories using Microsoft Excel or OpenOffice Calc

Note: EPA is updating this tool, so stay tuned for a new version coming soon.

Documenting KCA Results

- *Save copies of the file as different versions for draft and final analyses by inserting the date or version number at the end of the file name (e.g., "KCA Tool v2.xls").*
- *You may also use the 2006 IPCC Guidelines inventory software, which has a KCA module in it, or build your own spreadsheet(s) that follow the methodologies in the 2006 IPCC Guidelines.*

STEP 3: Complete the Approach 1 key category current year level assessment

- *Complete Table 5-1, below, using the results from the KCA you performed in Step 2. This table will be a record of the results of the IPCC Approach 1 key category level assessment for the most recent or current year (e.g., 2019). Add as many rows to the table as necessary to provide detailed information for each category.*
- *If or when the inventory is updated, update the KCA.*

Approach 1 Assessment (Current Year)

Table 5-1: Key Categories Based on Contribution to Total National Emissions

IPCC Category Code	IPCC Category	Gas	Current Year Emissions (Gg CO_2 Eq.)	Contribution to National Emissions	Cumulative Per Cent of National Emissions

*Represents results from the "Key Category Approach 1 Assessment for the Current Year" sheet in the EPA KCA tool.

STEP 4: Complete the Approach 1 key category base year level assessment and trend assessment

- *Complete this step if your country has GHG inventories with a time series of more than one year.*
- *If your country has a GHG inventory for only one year, proceed to Step 5.*

How this Template Will Help!

The *Key Category Analysis Tool and Template* will help the inventory team:

- Identify, document, and summarize all key categories identified using latest Inventory based on approaches available
  - Approach 1
  - Approach 2 (reflects uncertainty)
  - Qualitative criteria
- Document inventory improvements for the future

Action Items for Key Category Analysis

1. Assign specific responsibilities for who will do the KCA
2. Collect all emissions and removal estimates and if available, also the corresponding uncertainty assessments
3. Ensure analysis is at appropriate level of disaggregation
4. Conduct the Key Category Analysis
5. Document KCA results in the template
6. Identify inventory improvements based on KCA results
7. Archive analysis and KCA data for future inventories, review, and staff training

Where to Obtain the Key Category Analysis Tool

Available Online at

https://www.epa.gov/ghgemissions/toolkit-building-national-ghg-inventory-systems

5. Key Category Analysis (KCA)

This template identifies the sources and sinks that make the greatest contribution to national GHG emissions and removals. With this analysis of key categories, a GHG inventory team can prioritize over time the resources needed to implement the more impactful improvements to a national GHG inventory.

- Key Category Analysis (12 pp, 124 K)
- Key Category Analysis (PDF) (12 pp, 486 K)

Supporting Tool: The **Key Category Analysis Tool** enables a GHG inventory team to determine key categories of GHG emissions and removals from GHG inventory estimates.

- Key Category Analysis Tool (MB)

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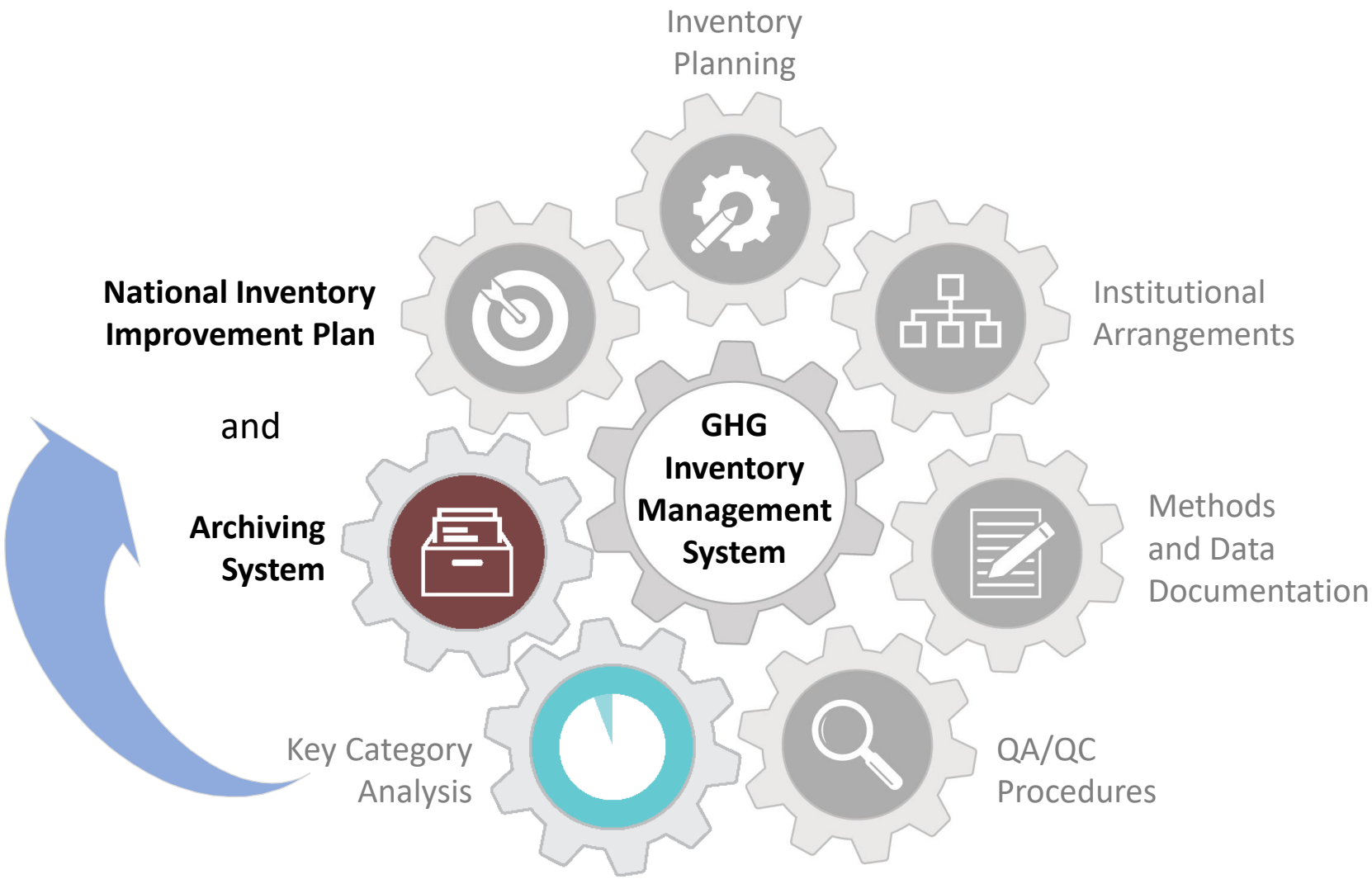
Next template…



Thank You For Your Attention!

For questions & more information, email:

ghgi.transparency@epa.gov

Toolkit for Building National GHG Inventory Systems

https://www.epa.gov/ghgemissions/toolkit-building-national-ghg-inventory-systems