Key Category Analysis

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

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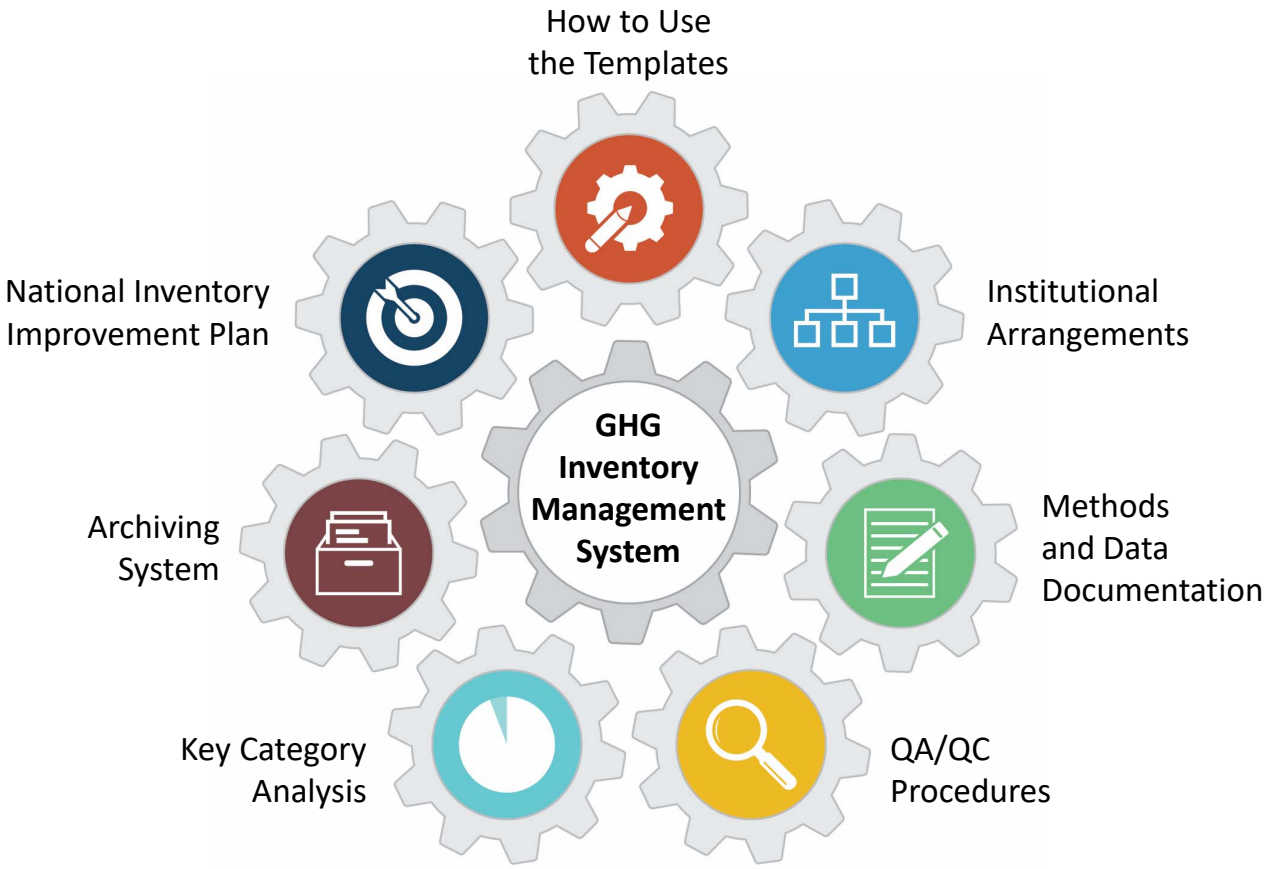
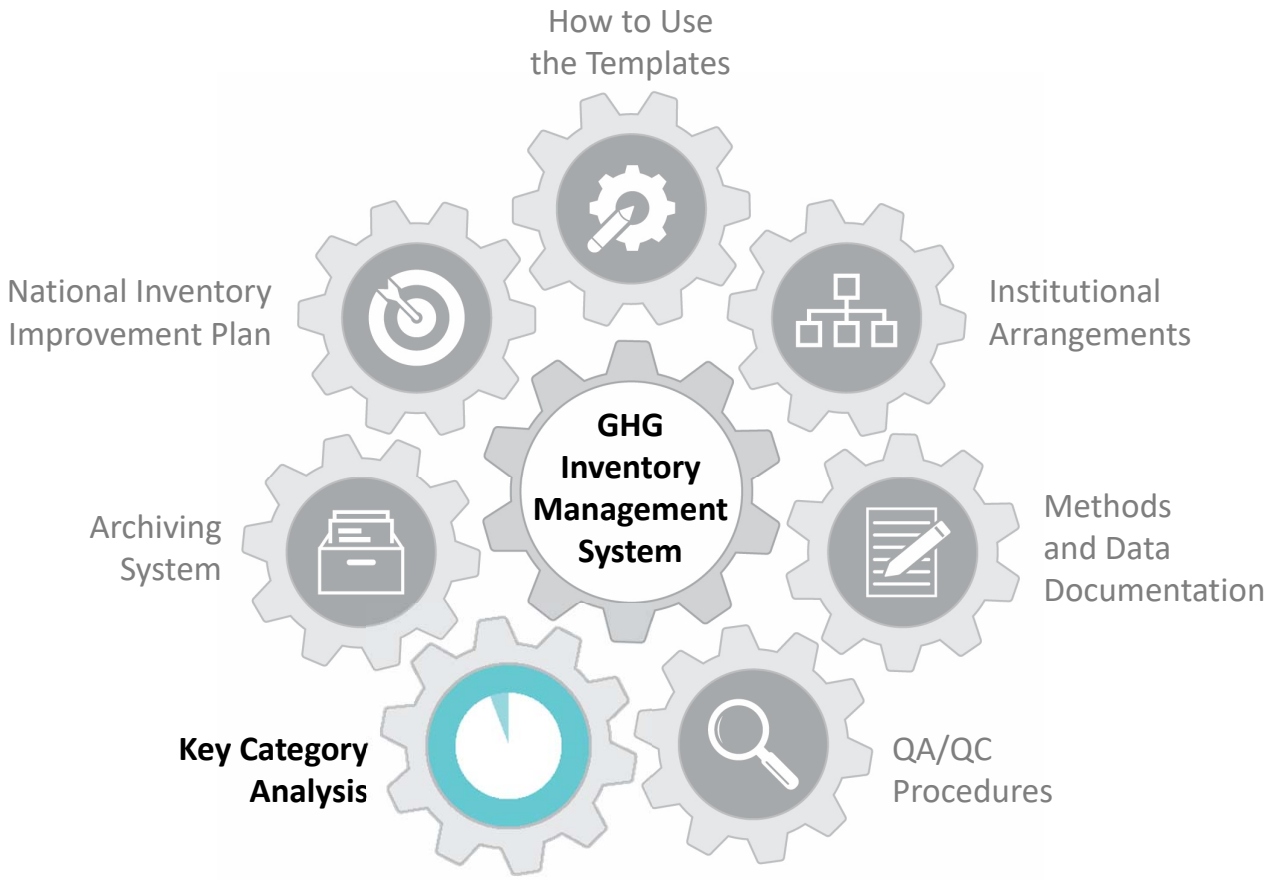
U.S. Environmental Protection Agency

November 18, 2021

Developing a Sustainable National GHG Inventory System



Key Category Analysis



Poll Question #1

Are you familiar with the concept of key categories?

a) Yes
b) No

Respond using Mentimeter link in the chat!

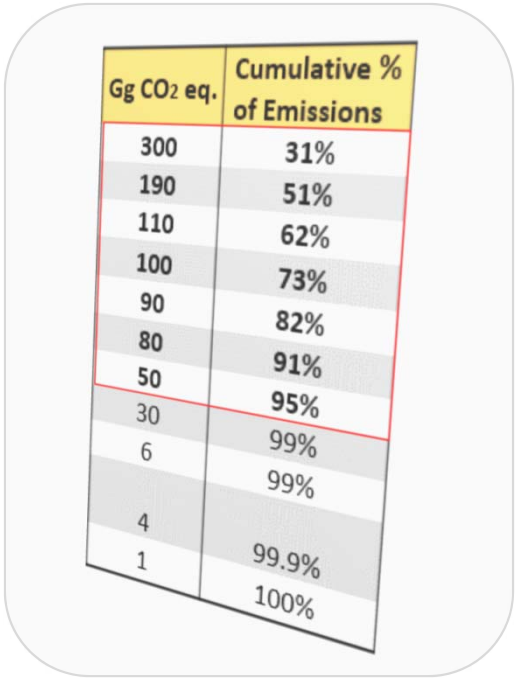
Poll Question #2

What is a key category?

Please describe….

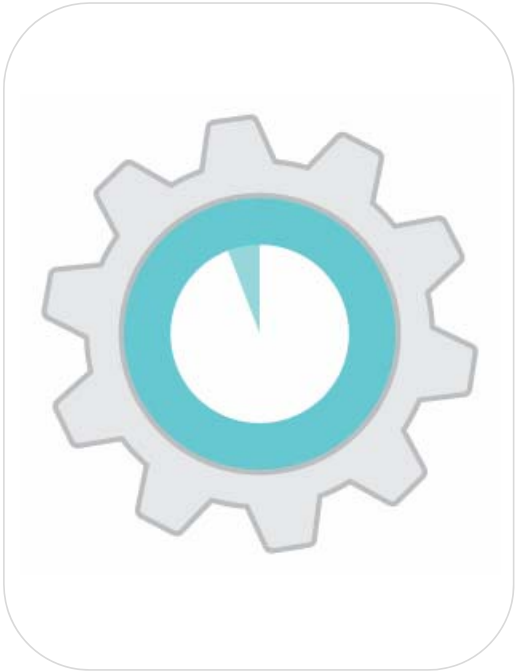
Respond using Mentimeter link in the chat!

Overview



Gg CO_2 eq.	Cumulative % of Emissions
300	31%
190	51%
110	62%
100	73%
90	82%
80	91%
50	95%
30	99%
6	99%
4	99.9%
1	100%

Introduction to Key Category Analysis



Review of the Template & Tools

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

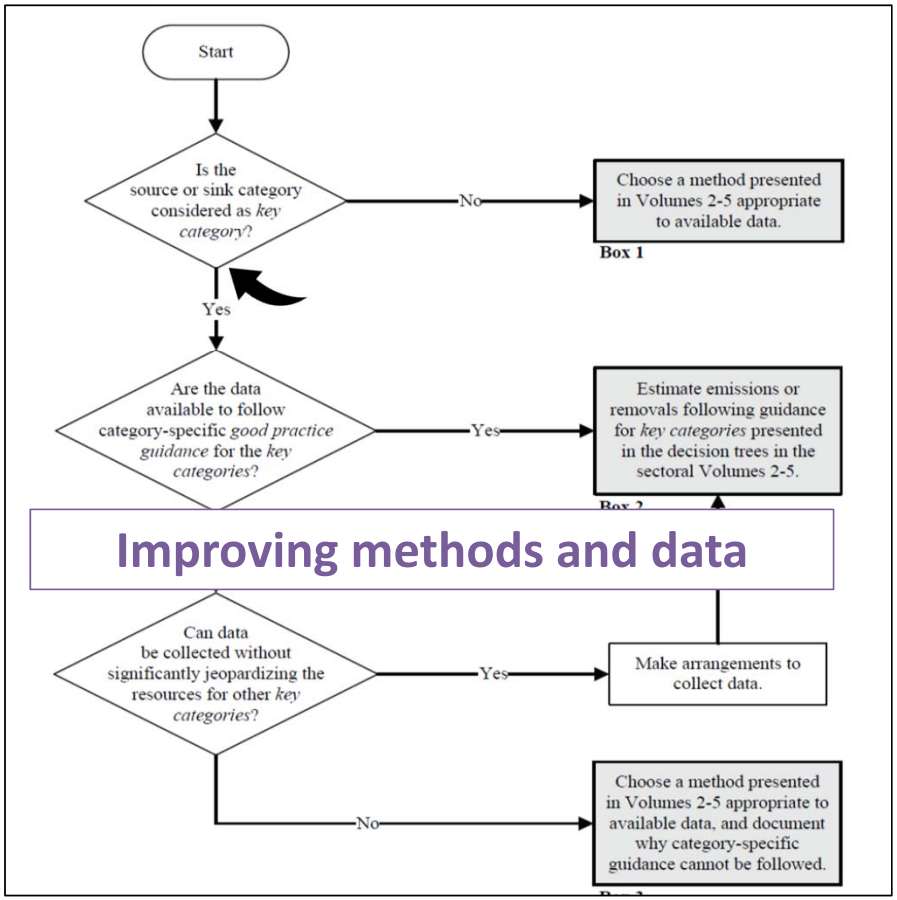
Absolute level contribution to total emissions

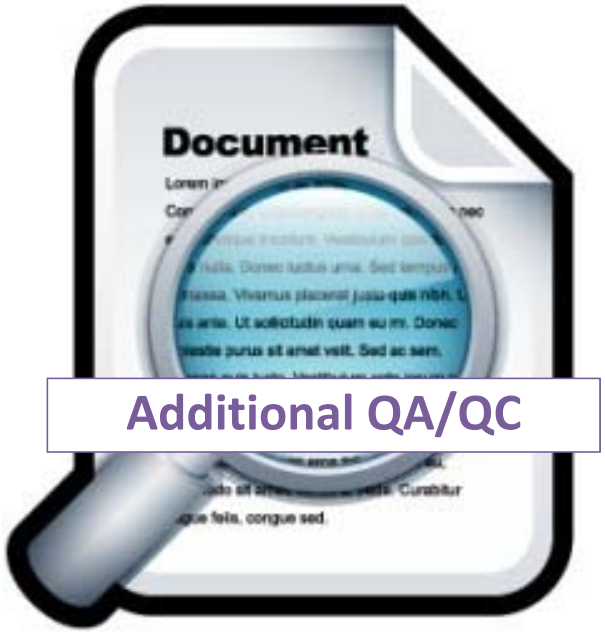
Trend: High growth rate in emissions

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 estimates, uncertainty analysis results, and other data 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 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

A quantitative assessment **identifies** key categories that collectively contribute at least 95% of national emissions in the current GHG inventory.

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

Note: If using the IPCC inventory software, KCA is performed automatically by the software as data is entered – no need to process separately

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 at disaggregation level consistent with IPCC guidance (i.e., estimates are organized by the categories, subcategories where applicable, and gases as defined in the 2006 IPCC GLs, Volume 1, Chapter 4)
   → *Perform including and excluding LULUCF sector*

Quantitative Assessment: Conducting an Approach 1 Level Assessment

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

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

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).

Key Category Analysis

Approach 1: Level Assessment | Approach 1: Trend Assessment

	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

Refresh Data | Export to Excel

Quantitative Assessment: Conducting an Approach 1 Level Assessment

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

Emission Category	Gas	Gg CO_2 eq.
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
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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	
Forest Land Remaining Forest Land	CO_2	190	
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		TOTAL : 961	

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	= 300/961 × 100%
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	
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Quantitative Assessment: Conducting an Approach 1 Level Assessment

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Emission Category	Gas	Gg CO_2 eq.	Cumulative %
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Quantitative Assessment: Conducting an Approach 1 Level Assessment

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Emission Category	Gas	Gg CO_2 eq.	Cumulative %
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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	
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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	95%
Cement Production	CO_2	30	99%
Croplands Remaining Croplands	CO_2	6	99%
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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.

Quantitative Assessment: Conducting an Approach 1 Level Assessment

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Sum to 95%

Quantitative Assessment: Conducting an Approach 1 Level Assessment

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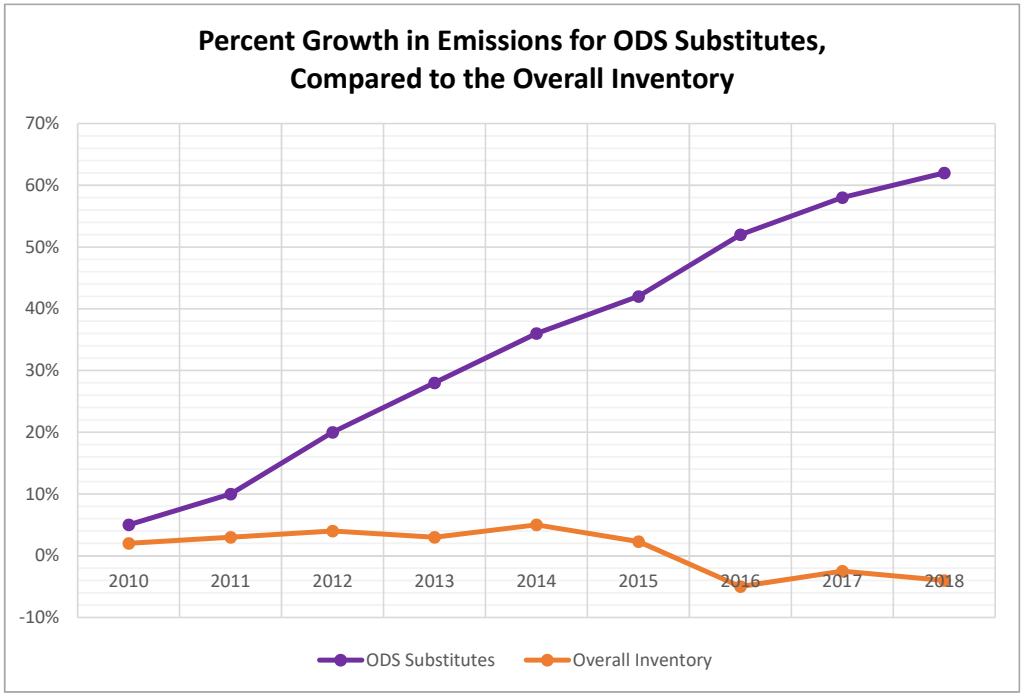
Cement Production	CO_2	30	99%
Croplands Remaining Croplands	CO_2	6	99%
Product Uses as ODS Substitutes (Aerosols)	HFC&PFC	4	99.9%
Iron and Steel Production	CH_4	1	100%

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.

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	HFC&PFC	45	50			
Cement Production	CH_4	35	30			
Croplands Remaining Croplands	N_2O	8	6			
Product Uses as ODS Substitutes (Aerosols)	CO_2	1	4			
Iron and Steel Production	CH_4	1.5	1			
		TOTAL: 410.5	**TOTAL: 581**			

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	0.08		
Forest Land Remaining Forest Land	CO_2	-210	-190	0.32		
Road Transport	CO_2	60	110	0.42		
Enteric Fermentation	CH_4	80	100	0.17		
Iron and Steel Production	CO_2	120	90	0.67		
Manure Management	CO_2	70	80	0.27		
Rice Cultivation	HFC&PFC	45	50	0.30		
Cement Production	CH_4	35	30	0.56		
Croplands Remaining Croplands	N_2O	8	6	0.67		
Product Uses as ODS Substitutes (Aerosols)	CO_2	1	4	2.58		
Iron and Steel Production	CH_4	1.5	1	0.75		

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
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Iron and Steel Production	CH_4	1.5	1	0.75		
				TOTAL: 6.79		

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

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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	0.08	1.2%	1.2%
Forest Land Remaining Forest Land	CO_2	-210	-190	0.32	5%	6.0%
Road Transport	CO_2	60	110	0.42	6%	12.1%
Enteric Fermentation	CH_4	80	100	0.17	2%	14.6%
Iron and Steel Production	CO_2	120	90	0.67	10%	24.4%
Manure Management	CO_2	70	80	0.27	4%	28.4%
Rice Cultivation	HFC&PFC	45	50	0.30	4%	32.9%
Cement Production	CH_4	35	30	0.56	8%	41.1%
Croplands Remaining Croplands	N_2O	8	6	0.67	10%	50.9%
Product Uses as ODS Substitutes (Aerosols)	CO_2	1	4	2.58	38%	89.0%
Iron and Steel Production	CH_4	1.5	1	0.75	11%	100.0%
				TOTAL: 6.79		

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
Energy Industries (solid fuel)	CO_2	200	300	0.08	1%	1.2%
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Road Transport	CO_2	60	110	0.42	6%	12.1%
Enteric Fermentation	CH_4	80	100	0.17	2%	14.6%
Iron and Steel Production	CO_2	120	90	0.67	10%	24.4%
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Rice Cultivation	HFC&PFC	45	50	0.30	4%	32.9%
Cement Production	CH_4	35	30	0.56	8%	41.1%
Croplands Remaining Croplands	N_2O	8	6	0.67	10%	50.9%
Product Uses as ODS Substitutes (Aerosols)	CO_2	1	4	2.58	38%	89.0%
Iron and Steel Production	CH_4	1.5	1	0.75	11%	100.0%
				TOTAL: 6.79		

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

Sum to 95%

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	0.08	$=0.08*U_{x,2018}$		
Forest Land Remaining Forest Land	CO_2	-210	-190	0.32			
Road Transport	CO_2	60	110	0.42			
Enteric Fermentation	CH_4	80	100	0.17			
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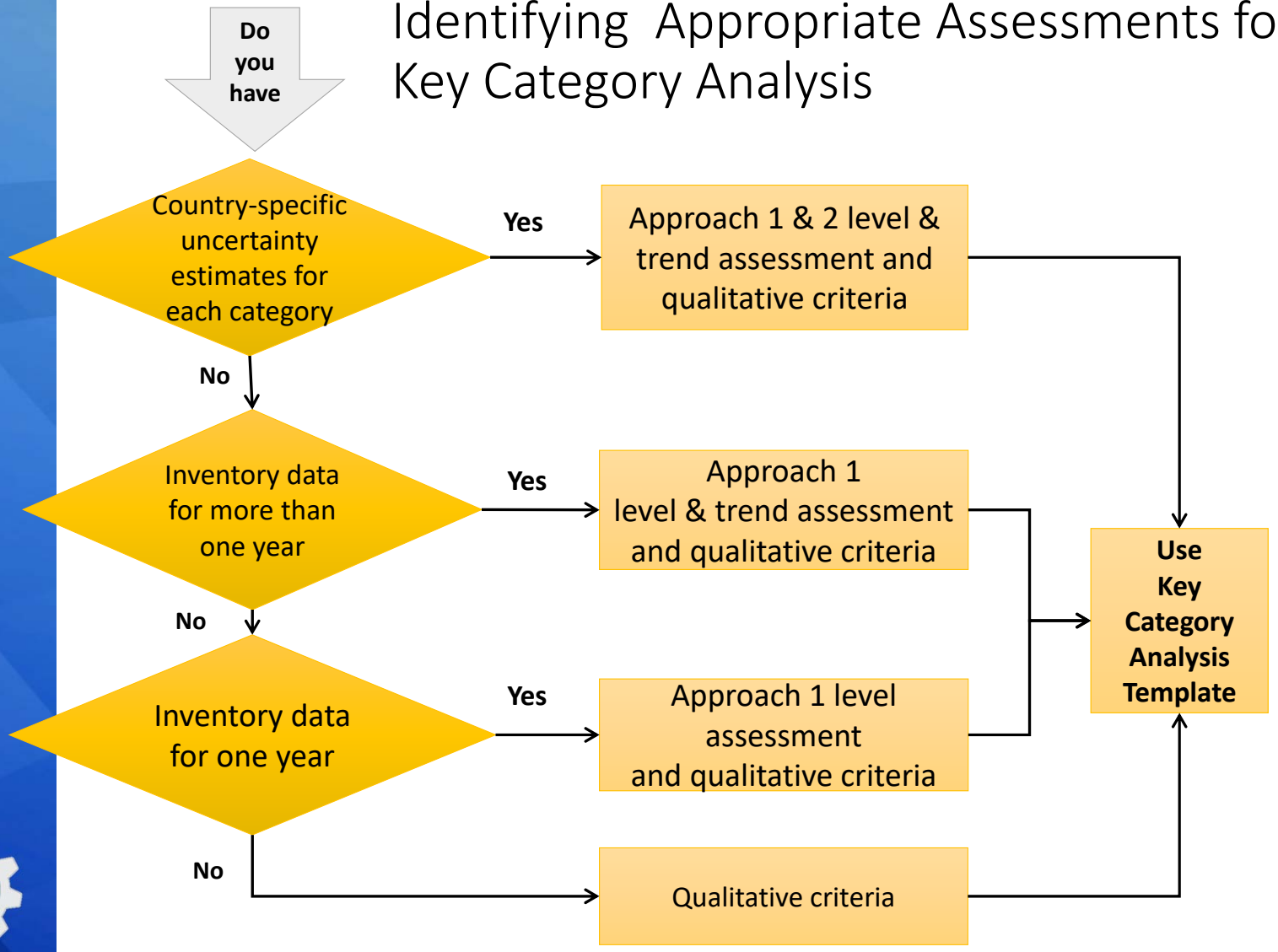
Product Uses as ODS Substitutes (Aerosols)	CO_2	1	4	2.58			
Iron and Steel Production	CH_4	1.5	1	0.75	**TOTAL: TBD**		

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)

Identifying Appropriate Assessments for Key Category Analysis



Data Checklist

- ☑ Qualitative criteria
- ☑ Inventory data for a single year
- ☑ Inventory data for more than one year
- ☑ Country specific uncertainty for each category

Recap: Why Do a Key Category Analysis?

Perform Key Category Analysis

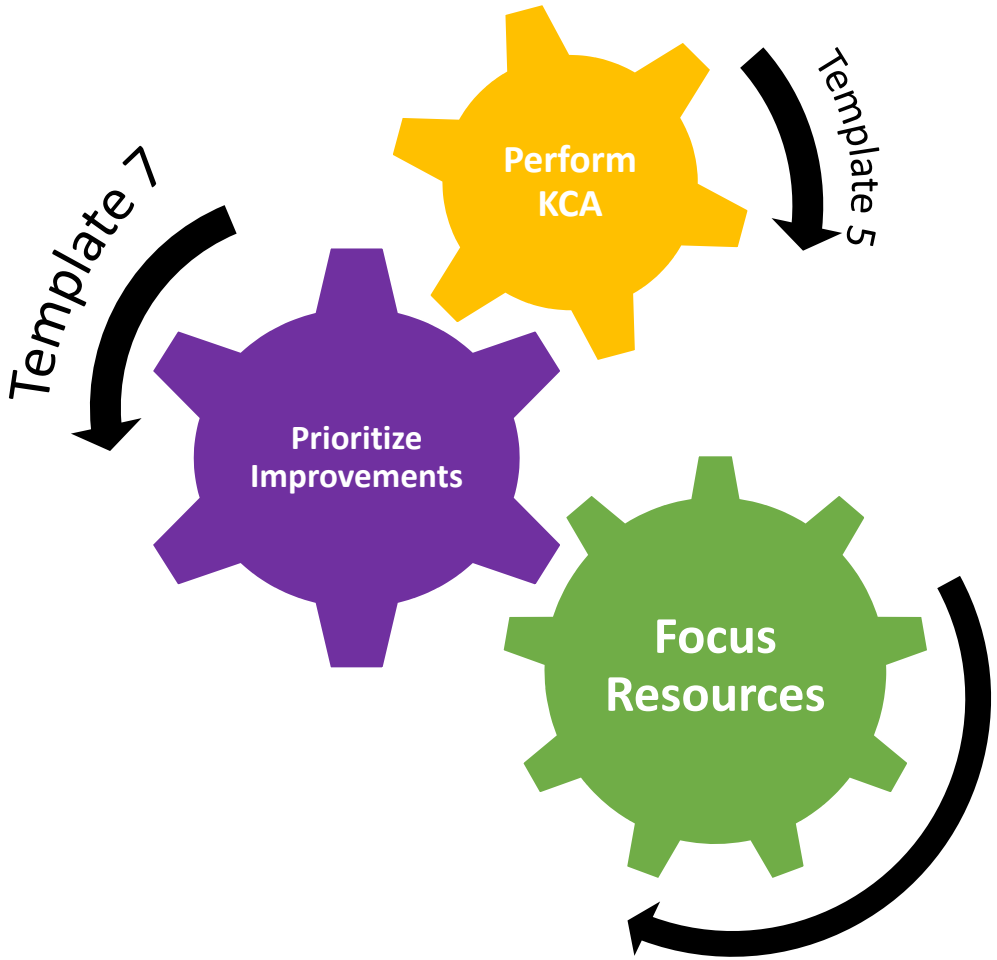
↓

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
- 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
- Revise estimates, based on QA/QC findings

- Estimate emissions & removals
- Implement QC procedures
- Revise estimates, based on QA/QC findings
- Conduct uncertainty & key category analyses

- Document methodological approaches and references
- Write inventory report

Poll Question #3

Does your latest National GHG Inventory include a key category analysis?

a) Yes
b) No

Respond using Mentimeter link in the chat!

Poll Question #4

Which tools did you use to conduct the key category analysis?

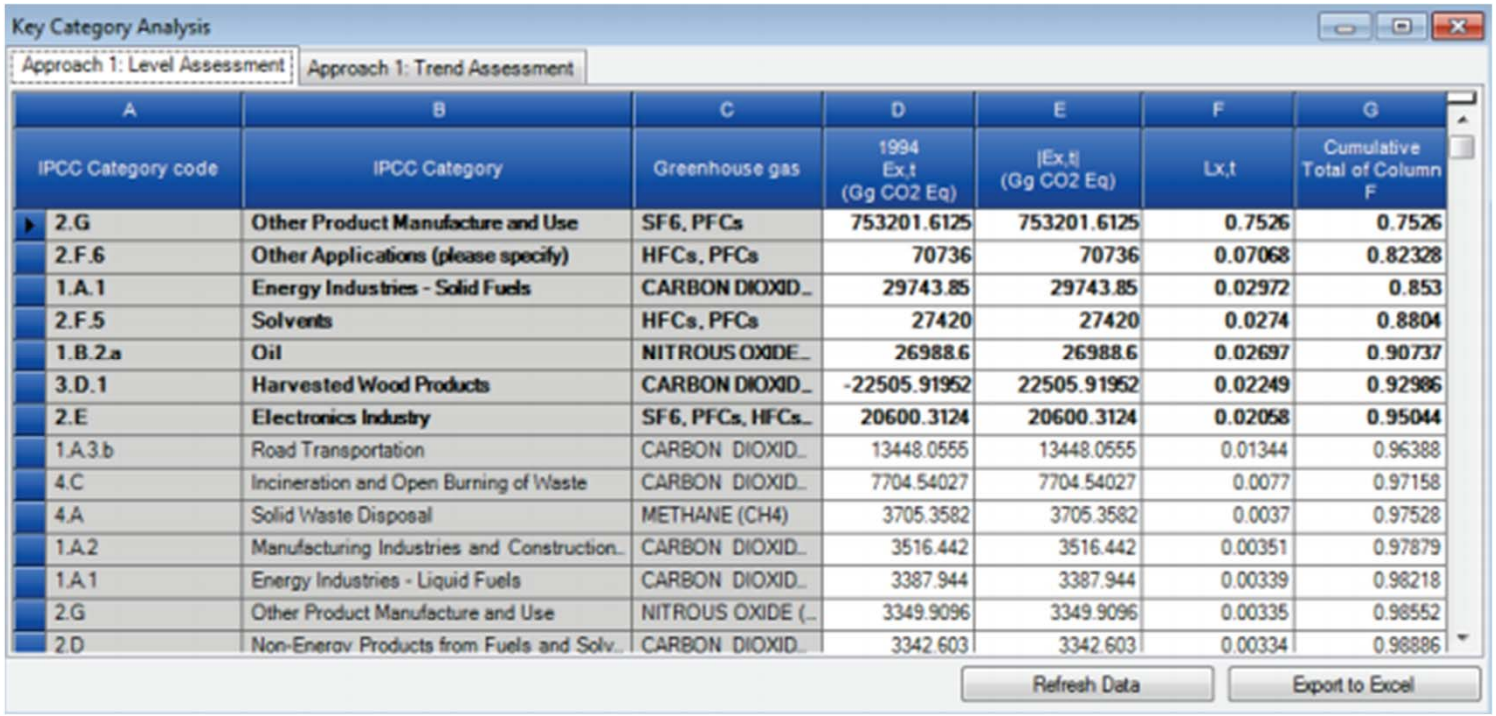
a) Spreadsheets
b) IPCC Inventory Software
c) Other

Describe Other using the poll/survey.

Respond using Mentimeter link in the chat!

IPCC Inventory Software

Automates preparing a 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

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

Where to Obtain the Key Category Analysis Tool

Download Link

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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The Key Category Analysis Tool

Instructions: Enter Inventory, click the ***Sort Key Categories*** button!

1. Verify that the current year estimates in column C correctly correspond to the categories in column B.
2. Click the **Sort Key Categories** button to the right.

Sort Key Categories

The resulting key categories are those categories shaded in green.

Key Category Tier 1 Level Assessment for the Current Year

CATEGORIES	Current Year Emission Estimate ($Gg\ CO_2$ eq)	Level assessment	Cumulative Percentage
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CH4	162,029	0.357	36%
2B9 - Chemical Industry - Fluorochemical Production - PFCs	162,029	0.146	50%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO2	113,945	0.102	60%
2C1 - Metal Industry -Iron and Steel Production - CH4	113,945	0.102	71%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO2	84,009	0.075	78%
2B8 - Chemical Industry - Petrochemical and Carbon Black Production - CH4	84,009	0.075	86%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - N2O	65,128	0.059	92%
2B9 - Chemical Industry - Fluorochemical Production - HFCs	65,128	0.059	98%
1A3d - Fuel Combustion Activities - Transport - Domestic Water-borne Navigation - N2O	16,127	0.014	99%
2F3 - Product Uses as Substitutes for Ozone Depleting Substances -Fire Protection - HFCs, PFCs	16,127	0.014	100%
3B2b - Land Converted to Cropland (Removals) - CO2	16,127	0.014	102%
3B5b - Forest Land Converted to Settlements (Removals) - CO2	16,127	0.014	103%
2B1 - Chemical Industry - Ammonia Production - CO2	11,076	0.010	104%
1C - Carbon Dioxide Transport and Storage - CO2	10,921	0.010	105%
2A1 - Mineral industry - Cement Production - CO2	8,122	0.007	106%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural gas - CO2	7,371	0.007	107%
2A2 - Mineral Industry - Lime Production - CO2	7,104	0.006	107%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO2	5,111	0.005	108%
2C3 - Metal Industry -Aluminium Production - PFCss	5,111	0.005	108%
1A3c - Fuel Combustion Activities - Transport - Railways - CH4	5,041	0.005	109%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs, PFCs	5,041	0.005	109%
3B2a - Cropland Remaining Cropland (Removals) - CO2	5,041	0.005	110%
3B5b - Land Converted to Settlements (Removals) - CO2	5,041	0.005	110%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO2	4,943	0.004	111%
2B9 - Chemical Industry - Fluorochemical Production - SF6	4,943	0.004	111%
1 - Miscellaneous - N2O	3,775	0.003	111%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CH4	3,768	0.003	112%
2C1 - Metal Industry -Iron and Steel Production - CO2	3,768	0.003	112%