Key category Analysis

Nalin SRIVASTAVA

IPCC TFI TSU

Latin American Workshop on National GHG Inventories Systems

Santiago de Chile

15-17 May 2013

WMO UNEP

ipcc

INTERGOVERNMENTAL PANEL ON climate change

The Problem

- Many inventory categories are small and have little impact on the final total or the trend.
- Resources are limited.
- Therefore want to focus effort on inventory categories that will have maximum impact in improving the estimates.
- How to identify the significant categories in a repeatable and consistent way?

Key Categories

- These are emission or removal categories that contribute most to the total or trend in emissions.
- Key Category Analysis (KCA) is the process to identify these sectors:

  *"A **key category** is one that is prioritised 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. Whenever the term **key category** is used, it includes both source and sink categories."*

- It is *good practice* to use a higher tier (at least Tier 2) for key categories.

Types of KCA Analysis

- **Quantitative Analysis** – numerical values that describe the contribution of a category to the national total emissions and their trend (Level and Trend Assessments)

- **Qualitative Analysis** – considers other criteria that are not easily assessed through a quantitative analysis

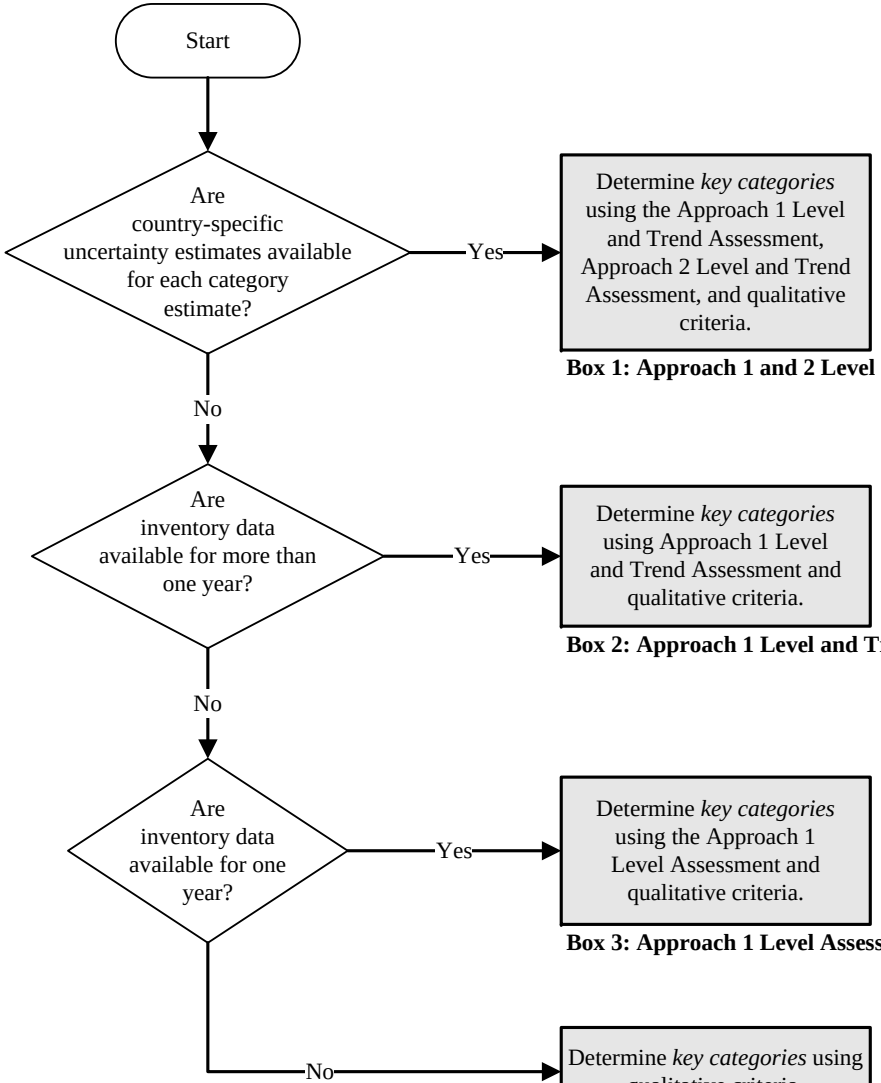
Steps

1. Prepare the list of categories based on the IPCC categories
    1. Identify special considerations related to analysis (e.g. fossil fuel combustion is a large emission category that can be broken down to sub-categories)
    2. Each greenhouse gas emitted from a single category should be considered separately
    3. Source categories that use the same EF based on common assumption should be aggregated before analysis
2. Perform quantitative analysis of the relationship between the level and the trend of each category emissions and total national emissions
    1. Use CO_2-equivalent emissions calculated using the global warming potentials (GWP)
3. Consider any qualitative considerations that would add additional key categories
4. Document the results and use in inventory compilation.

Approaches to Quantitative KCA

- Approach 1. Approach based on contribution to total and trend
  - Simple
  - Uses only data from emission/removal estimate
- Approach 2. Based on contribution to overall uncertainty
  - More complex
  - Needs a complete uncertainty analysis to have been performed
- The two approaches can be used together when setting priorities.

How to select Approach to use…



Box 1: Approach 1 and 2 Level and Trend Assessment

Box 2: Approach 1 Level and Trend Assessment

Box 3: Approach 1 Level Assessment

Box 4: Qualitative criteria

WMO UNEP

ipcc INTERGOVERNMENTAL PANEL ON climate change

Approach 1 – Level Assessment

$$Level = \frac{|category\ estimate|}{total\ contribution}$$

- "Contribution" is the sum of all the emissions and removals (expressed as positive numbers)
- Mathematically:

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

Approach 1 – Level Assessment (2)

- The level is calculated for each category.
- The largest ones that cumulatively add up to 95% of the total are selected.
- These are the *key categories*.

Example Calculation

			Emission/ Removal
1A1	Fuel Combustion Activities - Energy Industries	Coal	10000
1A1	Fuel Combustion Activities - Energy Industries	Oil	200
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Coal	1300
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Gas	123
1A3a	Fuel Combustion Activities - Transport - Civil Aviation	CO_2	5502
3A2	Manure Management	CH_4	543
3B1a	Forest Land Remaining Forest Land	CO_2	-2345
3B1b	Land Converted to Forest Land	CO_2	879

Example Calculation

			Emission/ Removal	Absolute
1A1	Fuel Combustion Activities - Energy Industries	Coal	10000	10000
1A1	Fuel Combustion Activities - Energy Industries	Oil	200	200
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Coal	1300	1300
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Gas	123	123
1A3a	Fuel Combustion Activities - Transport - Civil Aviation	CO_2	5502	5502
3A2	Manure Management	CH_4	543	543
3B1a	Forest Land Remaining Forest Land	CO_2	-2345	2345
3B1b	Land Converted to Forest Land	CO_2	879	879
				20892

Example Calculation

			Emission/ Removal	Absolute	Level
1A1	Fuel Combustion Activities - Energy Industries	Coal	10000	10000	47.9%
1A1	Fuel Combustion Activities - Energy Industries	Oil	200	200	1.0%
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Coal	1300	1300	6.2%
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Gas	123	123	0.6%
1A3a	Fuel Combustion Activities - Transport - Civil Aviation	CO_2	5502	5502	26.3%
3A2	Manure Management	CH_4	543	543	2.6%
3B1a	Forest Land Remaining Forest Land	CO_2	-2345	2345	11.2%
3B1b	Land Converted to Forest Land	CO_2	879	879	4.2%
				20892	

WMO UNEP

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Example Calculation

			Emission/ Removal	Absolute	Level
1A1	Fuel Combustion Activities - Energy Industries	Coal	10000	10000	47.9%
1A3a	Fuel Combustion Activities - Transport - Civil Aviation	CO_2	5502	5502	26.3%
3B1a	Forest Land Remaining Forest Land	CO_2	-2345	2345	11.2%
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Coal	1300	1300	6.2%
3B1b	Land Converted to Forest Land	CO_2	879	879	4.2%
3A2	Manure Management	CH_4	543	543	2.6%
1A1	Fuel Combustion Activities - Energy Industries	Oil	200	200	1.0%
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Gas	123	123	0.6%
				20892	

WMO UNEP

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Example Calculation

			Emission/ Removal	Absolute	Level	Cumulative
1A1	Fuel Combustion Activities - Energy Industries	Coal	10000	10000	47.9%	47.9%
1A3a	Fuel Combustion Activities - Transport - Civil Aviation	CO_2	5502	5502	26.3%	74.2%
3B1a	Forest Land Remaining Forest Land	CO_2	-2345	2345	11.2%	85.4%
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Coal	1300	1300	6.2%	91.6%
3B1b	Land Converted to Forest Land	CO_2	879	879	4.2%	95.9%
3A2	Manure Management	CH_4	543	543	2.6%	98.5%
1A1	Fuel Combustion Activities - Energy Industries	Oil	200	200	1.0%	99.4%
1A2	Fuel Combustion Activities - Manufacturing Industries and Construction	Gas	123	123	0.6%	100.0%
				20892		

Approach 1 – Trend Assessment

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

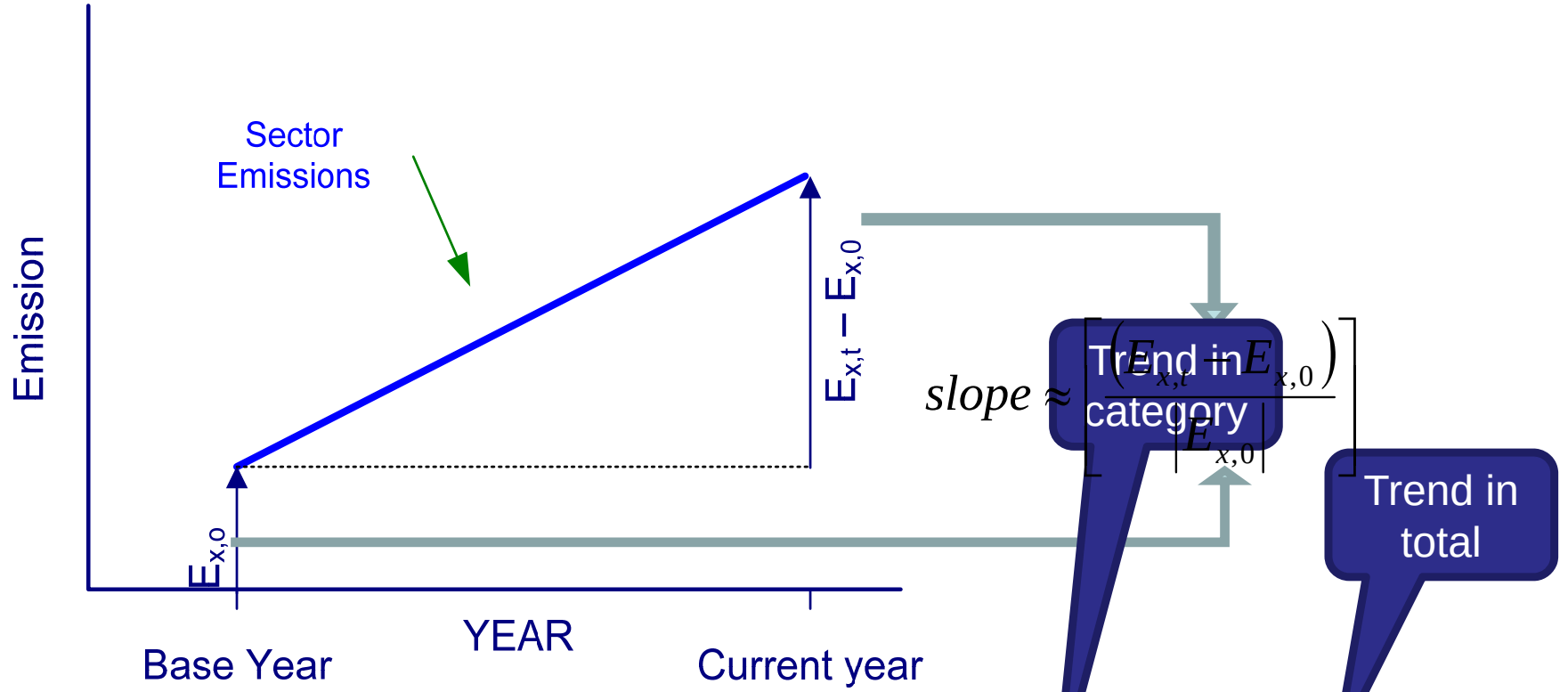
$$if \ \ zero \ in \ base \ \ year : T_{x,t} = \left| E_{x,t} \ / \sum_y \left| E_{y,0} \right| \right|$$

- Looks complex but easily to calculate with a spreadsheet (see guidelines)

WMO UNEP

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Approach 1 – Trend Assessment



$$T_{x,t} = \{\text{Category Significance}\} \times \left|[\text{category trend}] - [\text{overall trend}]\right|$$

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

Example Trend Assessment

Table 4.6
Example of Approach 1 Trend Assessment for the Finnish GHG inventory for 2003 (with key categories in bold)

A	B	C	D	E	F	G	H
IPCC Category Code	IPCC Category	Greenhouse Gas	$E_{x,0}$ (Gg CO_2 eq)	$E_{x,t}$ (Gg CO_2 eq)	Trend Assessment $T_{x,t}$	% Contribu-tion to Trend	Cumulative Total of Column G
3B1a	**Forest Land remaining Forest Land**	**CO_2**	**-23 798**	**-21 354**	**0.078**	**0.147**	**0.147**
1A1	**Energy Industries: Solid**	**CO_2**	**9 279**	**17 311**	**0.042**	**0.079**	**0.227**
1A3b	**Road Transportation**	**CO_2**	**10 800**	**11 447**	**0.040**	**0.076**	**0.302**
1A4	**Other Sectors: Liquid**	**CO_2**	**6 714**	**5 651**	**0.040**	**0.075**	**0.378**
1A2	**Manufacturing Industries and Construction: Solid**	**CO_2**	**6 410**	**5 416**	**0.038**	**0.072**	**0.450**
3B3a	**Grassland Remaining Grassland**	**CO_2**	**-1 071**	**2 974**	**0.037**	**0.069**	**0.519**
1A1	**Energy Industries: Peat**	**CO_2**	**3 972**	**9 047**	**0.035**	**0.066**	**0.585**
1A1	**Energy Industries: Gas**	**CO_2**	**2 659**	**6 580**	**0.029**	**0.054**	**0.639**
4A	**Solid Waste Disposal**	**CH_4**	**3 678**	**2 497**	**0.028**	**0.053**	**0.692**
3C4	**Direct N_2O Emissions from managed soils**	**N_2O**	**3 513**	**2 619**	**0.024**	**0.046**	**0.738**
1A2	**Manufacturing Industries and Construction: Liquid**	**CO_2**	**4 861**	**4 736**	**0.022**	**0.042**	**0.780**
3B2a	**Cropland Remaining Cropland**	**CO_2**	**1 277**	**211**	**0.017**	**0.031**	**0.811**

Approach 2: Level Assessment

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

- Where *L* is the level assessment and *U* the uncertainty for category *x* in year *t*
- Similar method to Approach 1 but select those that **contribute 90% cumulatively not 95%**

Approach 2: Trend Assessment

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

- Where *T* is the trend assessment and *U* the uncertainty for category *x* in year *t*
- Similar method to approach 1 but select those that **contribute 90% cumulatively not 95%**

Some qualitative criteria

- Mitigation techniques and technologies
- Expected growth
- No quantitative assessment of uncertainty performed (e.g. high uncertainty, large stocks)
- Completeness (incomplete inventory gives incorrect KC results); refer to Vol.1 Chapter 2 for the Approaches to Data Collection.

Example Reporting

Summary of key category analysis for Finland				
IPCC Category Code	**IPCC Category**	**Greenhouse gas**	**Criteria**	**Comments**
1A	Fuel Combustion Activities: Liquid	CO_2	L[illegible]2	Aggregated
1A	Fuel Combustion Activities: Solid	CO_2		Aggregated
1A	Fuel Combustion Activities: Peat	CO_2		Aggregated
1A1	Energy Industries: Solid	CO_2	[illegible]	
1A1	Energy Industries: Peat	CO_2	[illegible]	
1A1	Energy Industries: Gas	C[illegible]		
1A1	Energy Industries: Liquid			
1A2	Manufacturing Industries and Construction: Solid			
1A2	M[illegible]			
1A2	M[illegible]			
1A2	Manufacturing Industries and Construction: Peat	CO_2	L1, T1	
1A3b	Road Transportation	CO_2	L1, T1	
1A3b	Road Transportation: Cars with Catalytic Converters	N_2O	L2, T2	Aggregated
1A3c	Railways	CO_2	Q	Subjective Trend

L = *key category* according to level assessment; L1, L2
T = *key category* according to trend assessment; T1, T2
Q = *key category* according to qualitative criteria.

WMO UNEP

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Summary

- KCA identifies those source and sink categories that have most influence on the total emissions/removals and/or trend.
- Improvements to these categories will most improve an inventory.
- Compilers should focus resources on *Key categories.*
- It is *good practice* to use at least a Tier 2 method for *key categories*.
- Two approaches are provided – compilers should use the one that fits their needs.

Thank you!
Any Questions?

WMO UNEP

ipcc
INTERGOVERNMENTAL PANEL ON climate change