CEIP umweltbundesamt

Key Category Analysis (KCA)

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Basic problems

- Many inventory categories (emission sources) are small and have only a little impact to emissions
- Resources are limited
  - focus on most important sources/categories with biggest influence to the results (emissions)
- How do we identify the significant categories?

Key Category

- These are emissions that contribute the most to total emission or trend in emissions

- The Key Category Analysis (KCA) is the process on how to indentify 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 …”

- It‘s good practice to use higher tiers (at least 2) for key categories to have better estimates

Steps

- Prepare a list of categories based on the NFR categories
  - Identify special consideration to the analysis (e.g. some emission categories are large and can be broken into subsectors for the KCA analysis)
  - Perform the KCA for each pollutant (NOx, SO2, NH3, NMVOC, CO and PM10)
- Perform the quantitative analysis of the relationship between level and trend of each category emissions and total emissions
- Document the results and use (IIR and user manual)

Quantitative approaches

- **Approach 1**: based on contribution to total and trend
  - Relatively simply approach
  - Only uses data from emission estimates

- **Approach 2:** based on contribution to overall uncertainty
  - More complex
  - Needs a complete quantitative uncertainty analysis to have been performed

-> both approaches can be used together to set priorities

Approach 1: Level Assessment

- The „total contribution“ is the sum of all emissions
  Formular:

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

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

- The level is calculated for each category

- The largest one the cumulativley add up to **80%** are selected

Approach 1: Trend Assessment

- Formular:

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

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

-> looks complex but easily to calculate in Excel

Approach 2

- **L … level assessment**

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

- **T … trend assessment**

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

U... uncertainty for category x in year t

Qualitative approaches

- In some cases, the results of Approach 1 or 2 analysis of key categories may not identify all categories that should be prioritised in the inventory system.

- If quantitative key category analysis has not been carried out due to lack of completeness in the inventory, it is good practice to use qualitative criteria to identify key categories.

- Some criteria may not be readily reflected in the quantitative assessment. These criteria should be applied to categories not identified in the quantitative analysis and those that meet the qualitative criteria should be added to the list of key categories.

- It is particularly important to consider qualitative criterias if the trend assessment has not been compiled.

Qualitative criterias

- Mitigation techniques and technologies
  - if emissions from a category have decreased through the use of mitigation techniques, it is good practice to identify such categories as key. This will ensure that such categories are prioritised within the inventory and that better quality estimates are prepared to reflect the mitigation effects as closely as possible. It will also ensure that the methods used are transparent with respect to mitigation which is important for assessing inventory quality.

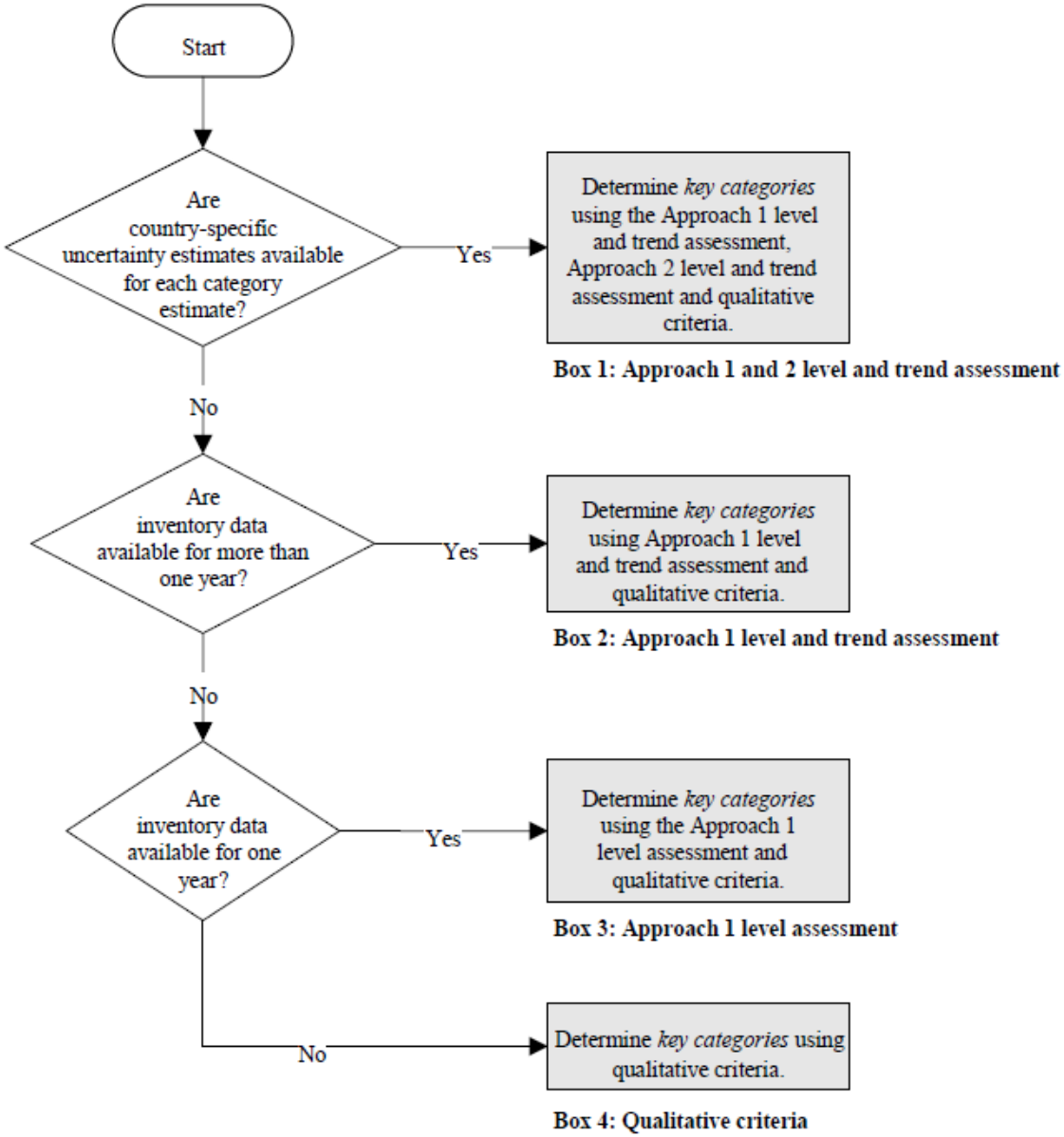
- Expected growth
  - the inventory compiler should assess which categories are likely to show an increase in emissions in the future. It is encouraged to identify such categories as key.

- No quantitative assessment of uncertainties performed
  - where Approach 2 including uncertainties in the key category analysis is not used, inventory compilers are still encouraged to identify categories that are assumed to contribute most to the overall uncertainty as key

Qualitative criterias

- Completeness
  - neither Approach 1 nor Approach 2 gives correct results if the inventory is not complete. The analysis can still be performed, but there may be key categories among those not estimated. In these cases it is good practice to examine qualitatively potential key categories that are not yet estimated quantitatively by applying qualitative considerations.
  - The inventory of a country with similar national circumstances can also often give good indications of potential key categories.

Decision tree to identify key categories



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Reporting and documentation

- It is good practice to clearly document the results of the key category analysis in the IIR

- Documentation should include a series of tables by pollutant showing the prioritised categories, explaining the choice of method for each category (using Tier 1, 2 or 3 notations) and listing the criteria by which each category was identified as key using the following notations:
  - L = key category according to level assessment
  - T = key category according to trend assessment
  - Q = key category according to qualitative criteria
  - 1 = Approach 1 (basic cumulative on magnitude of emission)
  - 2 = Approach 2 (applying uncertainty weightings)

→ e.g. L1, L2, T1, T2 or Q

Example – Summary of KCA (for NOx)

Quantitative method used: Approach 1

A	B	C	D	E
NFR Category Code	**NFR Category**	**Pollutant**	**Identification criteria**	**Comments [a]**
1.A.3.b.iii	Road transport: heavy-duty vehicles	NO_x	L1,T1	1.A.3.b.iii
1.A.3.b.i	Road transport: passenger cars	NO_x	L1,T1	1.A.3.b.i
1.A.2.f	Other (specify in a covering note)	NO_x	L1,T1	1.A.2.f
1.A.1.a	Public electricity and heat production	NO_x	L1,T1	1.A.1.a
2.D.1	Pulp and paper	NO_x	L1,T1	2.D.1
1.A.4.c.ii	Off-road vehicles and other machinery	NO_x	L1	1.A.4.c.ii
1.A.3.d.ii	National navigation	NO_x	L1	1.A.3.d.ii
1.A.2.d	Pulp, paper and print	NO_X	L1	1.A.2.d
1.A.4.c.iii	National fishing	NO_x	T1	1.A.4.c.iii

[a] Approach 1 used only for NO_X.

Example – Approach 1 level assessment

A[5]	B[5]	C[5]	D	E	F
NFR category code	NFR category	Pollutant	Latest year estimate $E_{x,t}$	Level assessment $L_{x,t}$	Cumulative total of column E
1.A.3.b.iii	Road transport: heavy-duty vehicles	NO_X	44.87	0.26	0.26
1.A.3.b.i	Road transport: passenger cars	NO_X	28.12	0.16	0.42
1.A.2.f	Other (specify in a covering note)	NO_X	21.29	0.12	0.54
1.A.1.a	Public electricity and heat production	NO_X	12.84	0.07	0.62
2.D.1	Pulp and paper	NO_X	10.98	0.06	0.68
1.A.4.c.ii	Off-road vehicles and other machinery	NO_X	10.19	0.06	0.74
1.A.3.d.ii	National navigation	NO_X	5.96	0.03	0.77
1.A.2.d	Pulp, paper and print	NO_X	5.91	0.03	0.81 — see note
1.A.3.b.ii	Road transport: light-duty vehicles	NO_x	5.90	0.03	0.84
1.A.4.c.iii	National fishing	NO_x	4.53	0.03	0.86
1.A.4.b.i	Residential plants	NO_x	3.98	0.02	0.89
1.A.3.e.ii	Other mobile sources and machinery	NO_x	3.19	0.02	0.90

Example – Approach 1 level assessment

A[5]	B[5]	C[5]	D	E	F
NFR category code	NFR category	Pollutant	Latest year estimate $E_{x,t}$	Level assessment $L_{x,t}$	Cumulative total of column E

- column A: code of NFR categories
- column B: description of NFR categories including fuel type
- column C: pollutant
- column D: value of emission estimate of category x in latest inventory year (year t)
- column E: level assessment
- column F: cumulative total of column E

(5) This guidance is copied from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and has been modified to provide column headings relevant for air pollutant emissions.

Example – Approach 1 trend assessment

A	B	C	D	E	F	G	H
NFR category code	NFR category	Pollutant	$E_{x,0}$ (Gg)	$E_{x,t}$ (Gg)	Trend assessment $T_{x,t}$	% Contri-bution to trend	Cumulative total of column G
1.A.3.b.i	Road transport: passenger cars	NO_x	105.58	28.12	0.10	0.43	0.43
1.A.3.b.iii	Road transport: heavy-duty vehicles	NO_x	58.78	44.87	0.04	0.17	0.60
2.D.1	Pulp and paper	NO_x	10.46	10.98	0.02	0.07	0.67
1.A.1.a	Public electricity and heat production	NO_x	14.44	12.84	0.02	0.07	0.74
1.A.2.f	Other (specify in a covering note)	NO_x	34.04	21.29	0.01	0.03	0.77
1.A.4.c.iii	National fishing	NO_x	4.51	4.53	0.01	0.03	0.80
1.A.3.d.ii	National navigation	NO_x	7.89	5.96	0.00	0.02	0.82
1.A.4.a	Commercial/institutional	NO_x	3.32	0.42	0.00	0.02	0.84
1.A.5.b	Other, mobile (including military)	NO_x	4.63	1.24	0.00	0.02	0.86
1.A.3.e.ii	Other mobile sources and machinery	NO_x	3.33	3.19	0.00	0.02	0.88

Example – Approach 1 trend assessment

A[5]	B[5]	C[5]	D	E	F	G	H
NFR category code	NFR category	Pollutant	Base year estimate $E_{x,0}$	Latest year estimate $E_{x,t}$	Trend assessment $T_{x,t}$	% Contribution to trend	Cumulative total of column G
Total					$\sum T_i$	1	

- column A: code of NFR categories
- column B: description of NFR categories
- column C: pollutant
- column D: year 0 estimate of emissions from the national inventory data
- column E: latest year estimate of emissions from the most recent national inventory data
- column F: trend assessment
- column G: percentage contribution of the category to the total of trend assessments in last row of column F
- column H: cumulative total of column G, calculated after sorting the entries in descending order of magnitude according to column G

(5) This guidance is copied from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and has been modified to provide column headings relevant for air pollutant emissions.

KCA – Summary

- KCA identifies those source categories that have most influence on the emissions estimates
- Improvements to these categories will most improve the inventory on the whole
- Compilers should focus resources on key categories
- It is good practice to use at least Tier 2 method for key categories

EMEP/EEA air pollutant emission inventory guidebook 2013:
http://www.eea.europa.eu/publications/emep-eea-guidebook-2013