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Statistical Issues in Air Pollution Emissions Inventories

AIR EMISSION INVENTORIES : NEEDS FOR RELEVANT STATISTICS

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Plan

Short introduction to air emission inventories

Requested qualities for inventories and statistics

Problems and possible solutions (some)

Challenges

Conclusion

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Short introduction to air emission inventories

- Emission inventories describe the input of substances into the atmosphere.
- They provide quantitative and qualitative information.
- They are generally limited to the primary emission, while air modelling is estimating secondary emissions due to physical and chemical transformations into the atmosphere.

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Short introduction to air emission inventories

⌘ Emission inventories are typically developped according to four dimensions with regard to coverage and resolution

Substances / species	~ 1 to 200 compounds
Sources / sub-sectors	whole total up to > 500
Geographical area / resol.	1 x 1 km^2 to 1 country
Period of time / resolution	1 hour to 1 year

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Short introduction to air emission inventories

Current emission inventories focus especially on :

- Acidification, eutrophication, photo-chemistry : SO_2, NOx, NH_3, NMVOCs, CO
- Greenhouse effect : CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 (GWP)
- Heavy metals : As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn
- Persitent Organic Pollutants (POPs) : dioxins and furans, PAHs, HCB, PCBs, SCCP, PCP, etc.
- Particulate Matter : TSP, PM_{10}, $PM_{2.5}$

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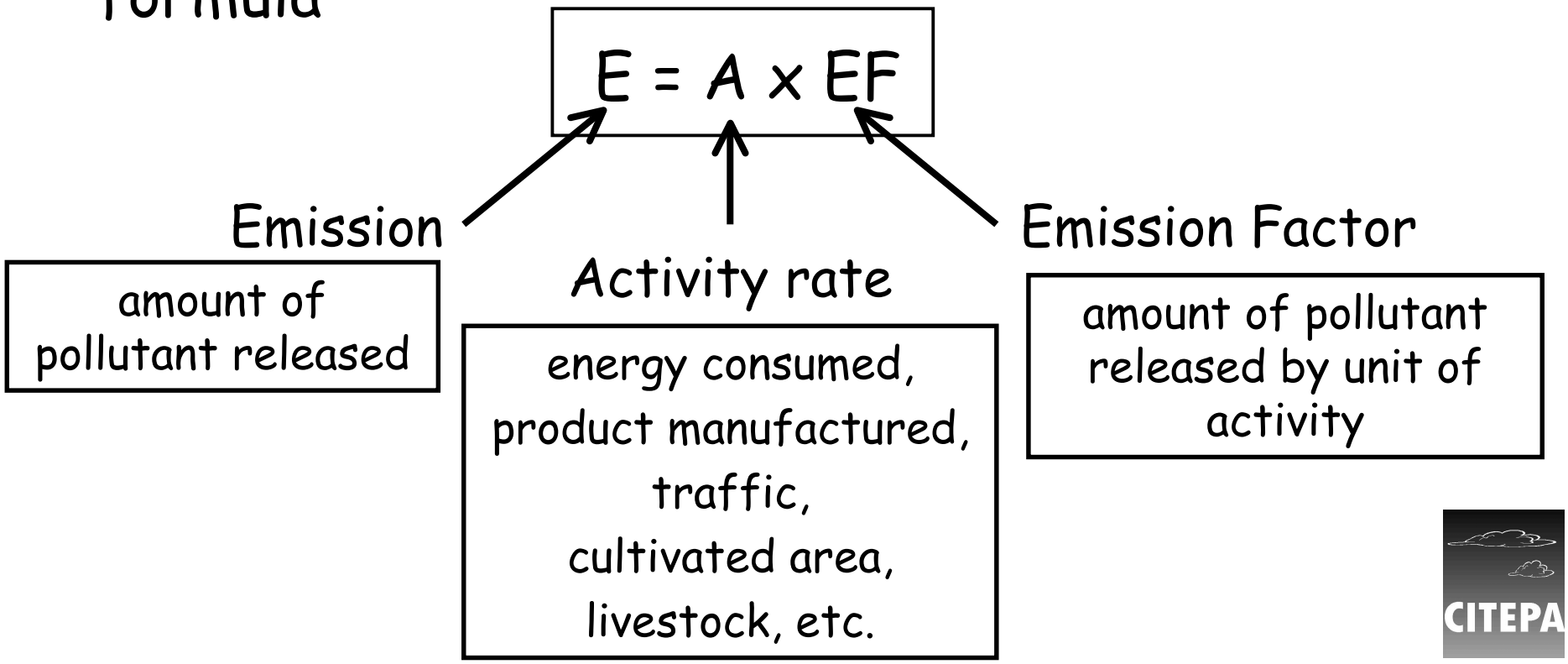
Short introduction to air emission inventories

⌘ The estimations are based on the very simple formula



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Short introduction to air emission inventories

- In fact, emission factors depend on various parameters (ie. technology used, operating conditions, etc.). For example : car emissions vary with type of vehicle, engine, catalyst equipment, age, driving conditions, etc.

Short introduction to air emission inventories

- A more complete description is illustrated with the following formula :

$$E_{s,t,z} = \sum_{a,i,f} \left[A_{a,i,f,t,z} \times \sum_{p} \left[F_{s,a,i,f,p} \times P_{a,i,f,p} \right] \right] \quad (1)$$

A :	activity rate	i :	economic sector indicator
F :	emission factor	p :	process indicator
P :	part of sector activity	s :	substance indicator
a :	source type indicator	t :	time interval indicator
f :	fuel type indicator	z :	geographical indicator

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Short introduction to air emission inventories

- It can be observed that the compilation of emission inventories requests the use of a lot of socio-economical and technical statistics

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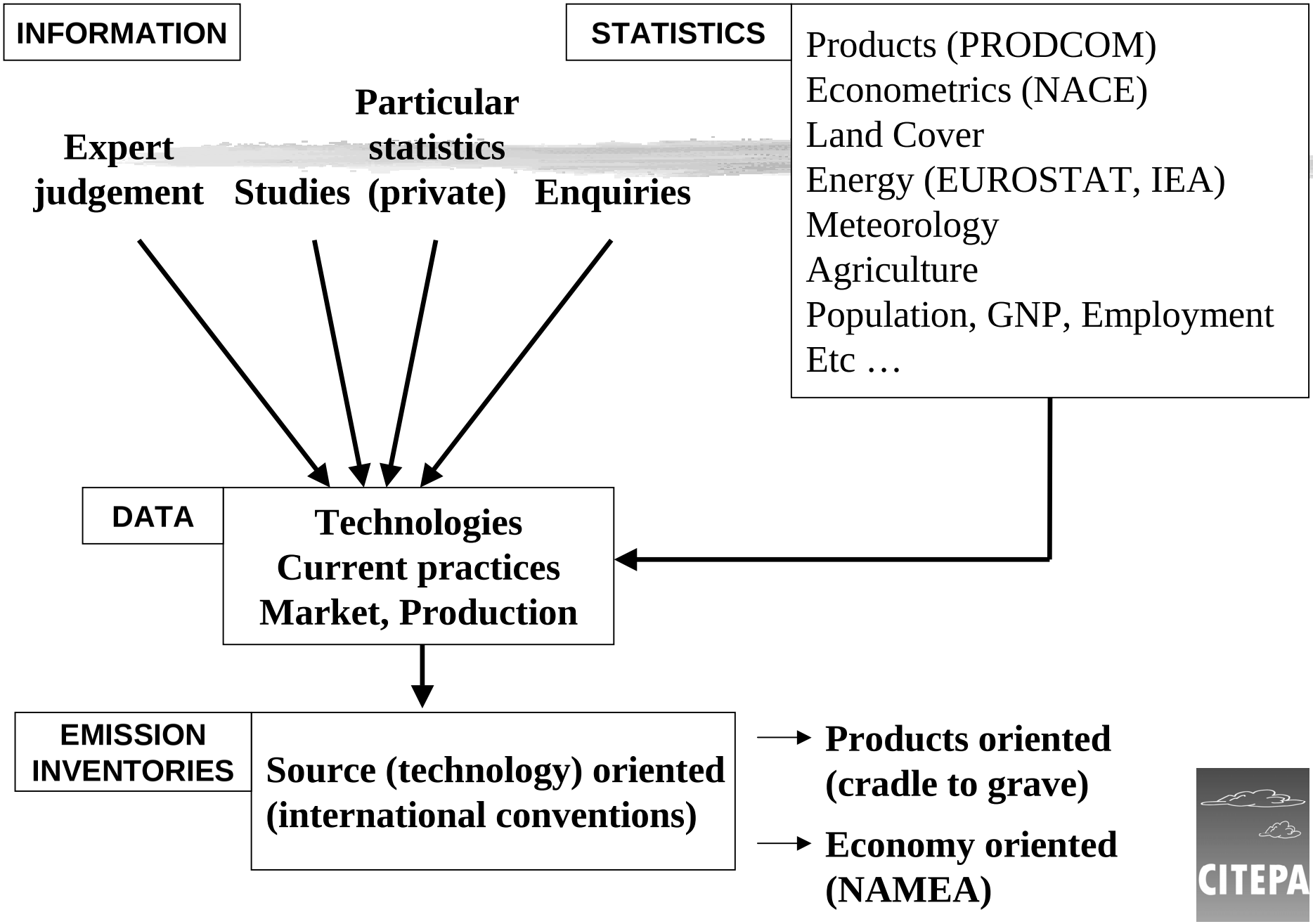
INFORMATION
STATISTICS
Products (PRODCOM)
Econometrics (NACE)
Land Cover
Energy (EUROSTAT, IEA)
Meteorology
Agriculture
Population, GNP, Employment
Etc …
Expert judgement
Studies
Particular statistics (private)
Enquiries
DATA
Technologies
Current practices
Market, Production
EMISSION INVENTORIES
Source (technology) oriented (international conventions)
Products oriented (cradle to grave)
Economy oriented (NAMEA)
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Short introduction to air emission inventories

- What qualities are requested to air emission inventories and therefore to statistics ?
- What are the difficulties and the possible solutions ?
- What are the challenges ?

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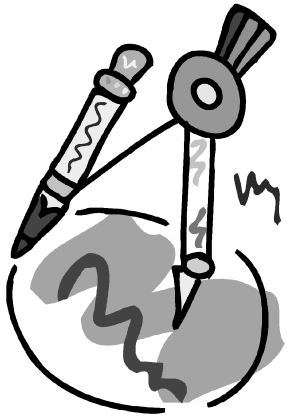
Qualities requested

Qualities requested to inventories and therefore to statistics :



- Consistency : same methods, same sources over the years

- Transparency : inventories have to be assessed by users or experts

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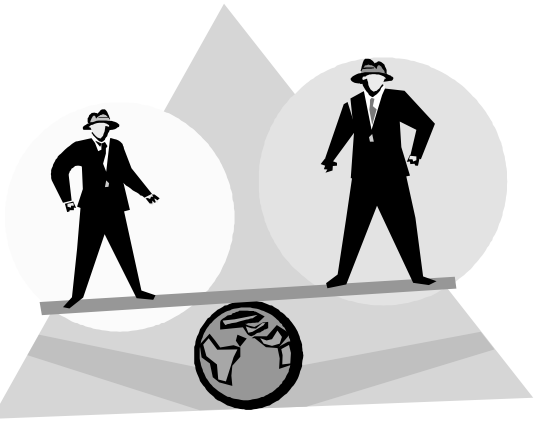
Qualities requested

- Comparability : to be applied to spatial, time and sectoral components. Effective only where consistency and transparency are real



- Timeliness : availability in due time

- Accuracy : reliability and uncertainty should be provided

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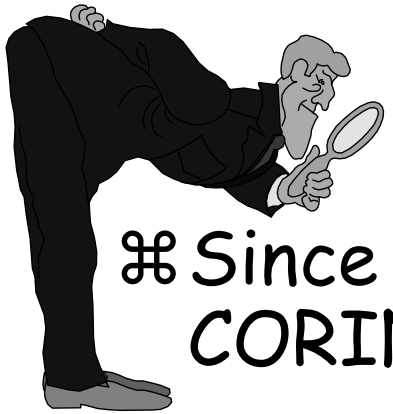
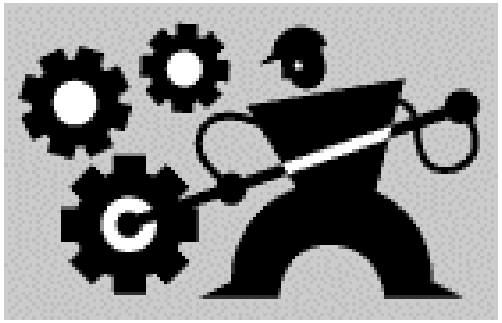
Problems and solutions (some)



- Since the 80s, scientific programmes (OECD, CORINAIR, etc.) identified the major gaps

- It was observed that most of socio economic statistics does not match with air emission needs



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Problems and solutions (some)

- Especially, all sources are not covered by NACE / ISIC, or statistics do not reflect relevant parameters. Therefore, specific background nomenclatures have been developped in Europe :
  - SNAP in the frame of CORINAIR (european standard internationally recognized)
  - NOSE developped by EUROSTAT

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Problems and solutions (some) (cont'd)

- Difficulty to change statistics → SNAP is still used, energy enquiries are recently changed
- Other difficulties are :
  - The consistency (not always guaranted in statistics)
  - The availability (not always provided in due time and limitation due to confidentiality rules). Changes are expected with regard to legal demands.
  - Estimation of uncertainty (generally not attached to statistics)
  - Various possible procedures may be used to solve these difficulties (extrapolation, right to change data retrospectively, special arrangements)

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Problems and solutions (some) (cont'd)

- At local or regional levels the same issues are met with more acuteness (confidentiality, availability). Typically, top-down procedures are implemented by using more or less simplified socio-economic indicators. Specific QA/QC procedures are also necessary where bottom-up procedures are used.

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Problems and solutions (some) (cont'd)

- PRODCOM (EUROSTAT) does not give indication on the technology used.
- Energy statistics provide amount of fuel sold while air emissions depend on fuel consumed (for Luxembourg the difference is 30% regarding road traffic, other difficulties occur with international/domestic shares).
- Energy / products statistics do not reflect the fate of some products (production/intermediate use/final uses), therefore it is difficult to determine what is used, where and when. Case of petrochemicals, solvents, fluoride compounds (HFCs, PFCs, SF_6), etc.

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Problems and solutions (some) (cont'd)

- Use of energy generally not available according to the combustion equipment.
- Forest inventories based on different definitions, a 10 years cycle (France).
- Lack of complete coverage in some sectors (eg. firms selected according to employment criteria)
- Statistics adjustements need to be allocated somewhere to emitters (no emissions not allocated)

- Discrepancy between statistics due to various considerations about conversion, data treatment between national and international offices (eg. EUROSTAT, IEA, some countries)

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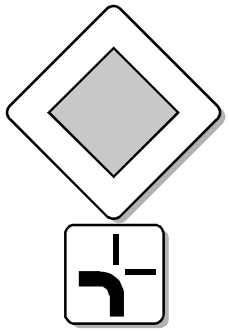
Problems and solutions (some) (cont'd)

- International harmonisation (eg. CRF and NFR reporting nomenclatures for air emission inventories)

- Scientific studies to reconcile use of data, methodologies
- Cooperation between inventory experts (users of statistics) and statistics experts (producers of statistics) in order to develop « useful » data



- Define priorities to develop more appropriate information (eg. on the basis of a key source analysis)

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EVALUATION DES SOURCES CLEFS - ANALYSE DES EVOLUTIONS DES EMISSIONS (*)

source CITEPA / CORALIE format UNFCCC mise à jour 21/12/2001 serre_dec2001/s_cle_evol.xls

	Catégrories Sources IPCC		Gaz à effet de serre direct	CO2 équivalent (Gg) en 1990	CO2 équivalent (Gg) en 2000	Evaluation de l'évolution (**)	Contribution à l'évolution (%)	cumul (%)
1	1A3b	Road Transportation	CO2	111 403	128 462	0.036	20.69	20.7
2	2B3	Adipic Acid Production	N2O	14 806	3 204	0.021	12.37	33.1
3	1A2f	Manufacturing Industries / Other	CO2	33 705	25 528	0.014	8.28	41.3
4	2F1	Refrigeration and Air Conditioning Equipment	HFC	0	5 005	0.009	5.46	46.8
5	1A1a	Public Electricity and Heat Production	CO2	45 606	40 408	0.008	4.81	51.6
6	1A2e	Food Processing, Beverages and Tobacco	CO2	11 064	14 454	0.007	3.90	55.5
7	2B2	Nitric Acid Production	N2O	7 936	4 222	0.007	3.90	59.4
8	1A4b	Residential	CO2	57 135	58 633	0.005	2.71	62.1
9	1A4a	Commercial/Institutional	CO2	26 529	28 549	0.005	2.70	64.8
10	1A1b	Petroleum Refining	CO2	13 239	15 382	0.004	2.58	67.4
11	2A1	Cement Production	CO2	10 948	8 570	0.004	2.39	69.8
12	1A1c	Manufacture of Solid Fuels and Other Energy Industries	CO2	6 647	4 383	0.004	2.34	72.1
13	1A3b	Road Transportation	N2O	1 592	3 634	0.004	2.26	74.4
14	6A	Solid Waste Disposal on Land	CH4	17 819	15 768	0.003	1.90	76.3
15	1A3a	Civil Aviation	CO2	4 541	6 191	0.003	1.88	78.2
16	2E1	By-product Emissions	HFC	1 942	197	0.003	1.87	80.0
17	2C1	Iron and Steel Production	CO2	4 009	2 372	0.003	1.71	81.8
18	2F4	Aerosols/ Metered Dose Inhalers	HFC	0	1 495	0.003	1.63	83.4
19	2C3	Aluminium Production	PFC	2 290	854	0.003	1.52	84.9
20	1A2b	Non-Ferrous Metals	CO2	3 565	2 231	0.002	1.39	86.3
21	4A	Enteric Fermentation	CH4	30 836	29 133	0.002	1.28	87.6
22	1B1a	Coal Mining	CH4	3 569	2 339	0.002	1.27	88.8
23	1A2a	Iron and Steel	CO2	17 010	17 821	0.002	1.20	90.0
24	1A2c	Chemicals	CO2	14 424	15 108	0.002	1.02	91.1
25	1A2d	Pulp, Paper and Print	CO2	5 156	5 938	0.002	0.95	92.0
26	1B1c	Fugitive Emissions from Solid Fuels / Other	CH4	711	187	0.001	0.56	92.6
27	1B2b	Fugitive Emissions from Fuels / Natural Gas	CH4	2 457	1 907	0.001	0.55	93.1
28	4D	Agricultural Soils	N2O	51 975	50 571	0.001	0.56	93.7
29	2E2	Fugitive Emissions	PFC	560	85	0.001	0.51	94.2
30	1A4c	Agriculture/Forestry/Fisheries	CO2	10 711	10 076	0.001	0.49	94.7
31	2F6	Semiconductor Manufacture	PFC	160	607	0.001	0.49	95.2
	...	...	...					
	Total (*)			551 805	542 299	0.172	100.00	100.0

(*) Analyse hors UTCF (utilisation des terres, leur changement et la forêt)

(**) Analyse de l'évolution selon les bonnes pratiques du GIEC (cf. "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", équation 7.2, p.7.9, chap.7)

Challenges

These qualities are requested by official european and international organisations such as the Commission, the European Environment Agency, IPCC and especially the United Nations in the frame of :

- The framework convention on climate change (UNFCCC) and the Kyoto Protocol (KP)
- The convention on the long range transboundary air pollution (UNECE / LRTAP) and the various protocols (EMEP, Aarhus, Göthenburg, etc.)
- The EU directives on Large Combustion Plants (LCP), VOCs, National Emission Ceilings (NEC) and CO_2 trading

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Challenges

- Parties ratifying these conventions and protocols have among their commitments to reduce or limit their emissions below the targets and to report appropriate information in order to demonstrate that the changes are assessed on a relevant basis
- The issue deals with political aspects but also economical ones. For example, CO_2 trading could be affected where emissions are not assessed with sufficient accuracy and QA/QC
- On the opposite, some events such as the energy open market, the cost of statistics, etc. represent driving forces for the reduction of the availability of statistics in the future

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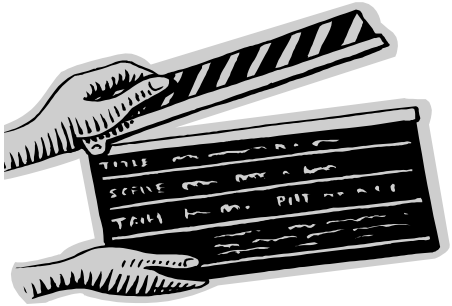
Conclusion

- There is a real need to make more and more available sustainable and relevant statistics dealing with some major international and local environmental problems for use in air emission inventories
- Progresses are observed but very slowly while challenging is increasing much more quickly
- Don't forget : knowledge is the first step allowing to decide and to act more efficiently



Thanks for your attention

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