EMISSION INVENTORY IN ALSACE : A TOOL TO CONTROL THE ATMOSPHERIC POLLUTION AND THE CLIMATIC CHANGE

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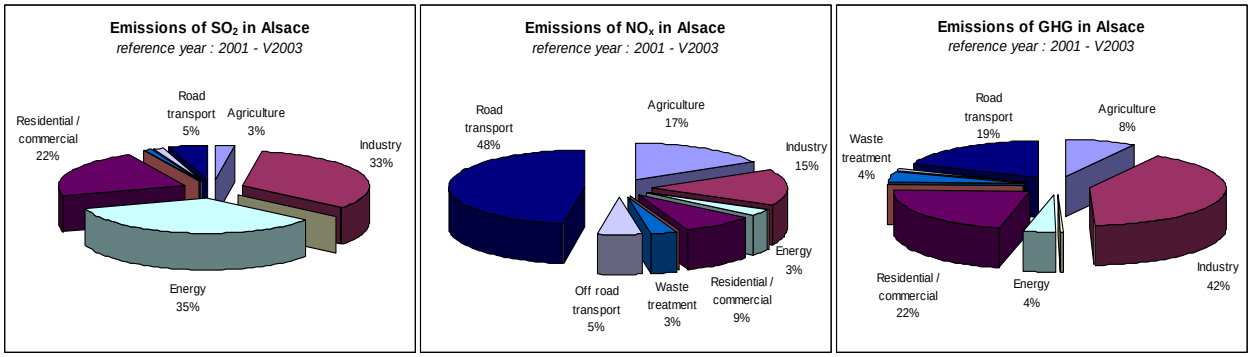
ABSTRACT
Through the national plan for combating the greenhouse effect, the local authorities are largely involved in the national effort of GES reduction regarding urbanism, transport, renewable energies, communication and consciousness-raising coming under the relevance of their close competency.
Thus, the local decision makers must have adequate decision-making tools to be able to identify the priority sectors to act upon to limit these impacts.
To meet this need, ASPA takes into account the major greenhouse gases (CO_2, N_2O, CH_4) in its annually updated emission inventory integrating all activities implicated. The multiple data sources are regional partners as well as regional and national data suppliers.
This inventory, covering the whole of Alsace region and Upper-Rhine valley in the framework of INTERREGIII program, gives knowledge for each territorial or local authority (region, county, town) of the levels of greenhouse gases emission and their sources (industrial, transport, residential, agricultural...).
Under the current economical constraints, development of ASPA's pollutants inventory towards greenhouse gases seems particularly adapted to supply local decision makers with a tool which is coherent with CITEPA's national inventories based on IPCC methods. This tool provides the opportunity for more implication of local authorities in the national plan for combating the greenhouse and thus to contribute their share to limit the climatic warming and its consequences.

ISSUES
The climatic warming is a major environmental issue whose consequences will affect a significant part of humanity with considerable and dramatic implications in term of drinkable water and food and thus will enhance geopolitical risks for the next decades.
In contrast to the majority of air pollution phenomena to which humanity was and still is confronted, the reduction of the greenhouse effect gas emissions will happen only through a drastic evolution of behaviours and lifestyles and through important technological ruptures. In France, the objective on the horizon of 2050, namely a division by 4 of the greenhouse gases emissions [1] [2], is a titanic challenge, much more difficult to achieve than the abatement of sulphur dioxide emissions (control of the industrial and energy station emissions like refineries - graph 1) or the abatement of automobile gases (postprocessing of exhaust fumes - graph 2). The emissions of all greenhouse gases (principally methane carbon dioxide nitrogen protoxide) are indeed largely multi-source (graph 3) and come at the same time from transport, industry, the residential, agricultural and waste processing sectors [3]. The question is therefore to deal at the same time with the large industrial emitters but also with the multitude of emissions from individual origin.



Graphs 1 to 3: distribution of the sulphur dioxide emissions, nitrogen oxides and greenhouse gases in Alsace for the year 2001.

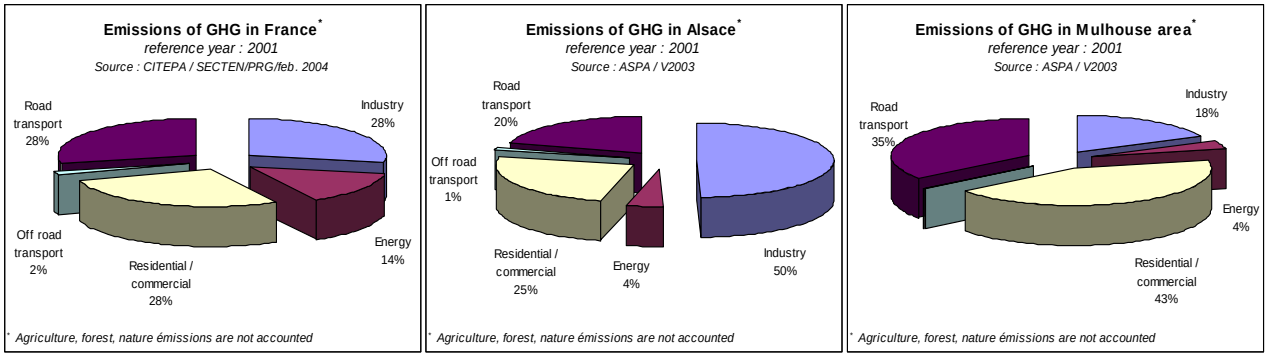
The European Union must achieve for the horizon 2008-2012 (basic year = 1990) a total reduction of 8% of its greenhouse gases emissions [4] (engagement relating to the Protocol of Kyoto of December 1997 and ratified in March 2002). Each State was attributed an individual objective, France having to stabilize its emissions (0% evolution between 1990 and 2008-2012). To reach these results, an arsenal of regulations is taking place, including the famous emissions quotas [5] for the large industrial emitters. Engagement of progress are also subscribed by the car manufacturers to reduce the carbon dioxide emissions per kilometre (average of 140 g/km by 2008 against 165 g/km in 2001 for the new models on the market [6]). But, beyond his engagements, regulated or not, each individual has also an important role to hold and can be an actor in modifying his consumption (industry) and lifestyle (heating, transport, processing waste). From their multiple competences, the Territorial and Local Authorities have indeed a crucial role to play, first as an information pole on climatic warming and its consequences but also as a trigger for setting up reduction actions. This implication is largely encouraged in France by the Inter-Ministerial Greenhouse Effect Mission : firstly with the national plans of emissions reduction and, secondly with the publication of practical works like the "Memorandum of the decision makers: Territorial Communities committed in the control of the greenhouse gases emissions"[7], a guide for regional and local greenhouse gases emissions reduction policies application. To orientate and pursue their emission reduction policies, the communities must be able to evaluate permanently on a local scale the effects of the actions carried out, programmed or potential.

OBJECTIVE

Within the framework of the Kyoto Protocol, each state has to report annually its greenhouse gases emissions. For this purpose, the IPCC (Intergovernmental Panel one Climate Changes) has set up reference methods for the coherency of all national inventories [8]. The emissions reporting makes it possible for the UNFCCC (United Nation Framework Convention one Climate Change) to follow each year the emissions evolution and to set up audits to insure the conformity to IPCC standards.

If they are representative of the national level and thus are of greatest interest for the application of industrial emission reduction policies or transit traffic management at the scale of a country (in particular modal carrying forward), these inventories do not make it possible to the regional and local decision makers to initiate the most relevant policies on their scale nor to the public to take part in climatic warming limitation. Indeed, the national emissions

distribution does not reflect acutely the local characteristics. Thus, the distribution by sector of greenhouse gases emissions can vary a lot depending on the given geographical area (country, region, urban unit) (graphic 4 to 6).



Graphs 4 to 6: distribution of the greenhouse gases emissions (excepted agriculture, **forestry** and nature) in France, in Alsace and in the SIVOM of Mulhouse for the year 2001.

This is why the local representatives of the State and the territorial and local Authorities entrusted ASPA for the setting up of the communal annual inventories of pollutants and greenhouse gases emissions [9]. The principal greenhouse pollutants were therefore included in ASPA's inventories with the following applications :

- determination, per geographical area, of the sectors responsibilities in the emission of polluting substances into the atmosphere:
  - to substantiate reflections in regard to the follow-up of the legal plans of emissions control;
  - to establish a decision-making tool for the application of pollution episodes precaution procedures (source of pollution levels reduction);
  - to evaluate the impact of a road, industrial or other project;
  - to ensure the promotion and the follow-up of the territorial pollutants and greenhouse gases reduction actions;
- objective estimate of the pollution weight orienting the monitoring strategy :
  - to provide elements of answers for the characterisation of the air quality of a whole territory;
  - to provide elements of decision for the optimisation of air pollution monitoring fixed stations network;
- supply of primary data for the implementation of a atmospheric pollutants concentrations land register (i.e. inhaled concentrations) using geo-statistical tools;
- integration in deterministic models of air quality diagnoses and forecasts (episode inventories integrating a VOC speciation and hourly emissions distribution keys).

METHOD [10]

The Alsatian emissions inventory allows to cover all the air pollution phenomena : proximity, urban, regional (acidification, photochemistry) and global (greenhouse effects) pollution. It integrates forty substances :

- pollutants : SO_2, NOx, CO, COVNM, PM_{10}, $PM_{2.5}$, HCl, HF, NH_3, benzene, dioxins and furans, Pb, Cd, As, Ni, Hg, Cr, Cu, V, Zn;
- PAH: 8 individualized polycyclic aromatic hydrocarbons;
- greenhouse gases :CO_2, CH_4, N_2O;
- Pesticides: various weedkillers, fungicides, insecticides and other products (growth regulators…).

It covers the whole of the emitting sectors and is elaborated according to Selected Nomenclature for Air Pollution with the following reporting distribution :

- Production/distribution of energy;
- Residential/commercial;
- Industry;
- Waste processing;
- Halogenous compounds;
- On-Road transport;
- Off-road transport;
- Agriculture;
- Forestry;
- Nature

To serve as an indicator for the emissions evolution in connection with the current reduction and emission control, the inventory is annually elaborated with a methodological revision of all the chronological series. It covers every part of Alsace (per commune or district) for annual updates and is extended to the Upper-Rhine valley within the framework of the INTERREG programs.

RESULTS AND DISCUSSION

The results of the pollutants and greenhouse gases emissions inventory are exploited in various programmes of air pollution levels reduction in Alsace. Two examples are presented:

- The Atmospheric Plan of Protection (PPA) of Strasbourg;
- The Bas-Rhin General Council action in favour of the sustainable development.

<u>Strasbourg Atmospheric Protection plan [11]</u>

The objective of the Strasbourg Atmospheric Protection plan is the application of measures to decreaseof the pollution levels under the limit values defined by the European Directives.

Within this framework, the emissions inventory has a double objective:

- On the one hand it allows to classify into sectors and geographical areas the pollutants emissions and thus to determine the emitters on which the efforts of emissions reduction or control must concentrate (table 1 and chart 1);
- In addition it supplies a deterministic air quality simulation model which evaluates the impact of the applied reduction measures by the horizon of 2010 (chart 2 and 3).

part de chaque secteur *(% des émissions)*	Production / distribution d'énergie	Industrie	Résidentiel / tertiaire	Traitement des déchets	Transports routiers	Transports non routiers	Agriculture	Sylviculture / nature
Gaz impliqués dans les phénomènes d'acidification et de photochimie								
SO_2	**74%**	9%	13%	-	-	-	-	-
NO_x	18%	6%	9%	6%	**54%**	-	-	-
NH_3	-	-	-	9%	20%	-	**68%**	-
HCl	**53%**	20%	9%	18%	-	-	-	-
HF	34%	10%	8%	**47%**	-	-	-	-
CO	-	-	11%	-	**85%**	-	-	-
COVNM	13%	32%	14%	-	33%	-	-	-
Particules								
PM_{10}	29%	7%	5%	-	**52%**	-	-	-
$PM_{2.5}$	31%	-	5%	-	**53%**	-	-	-
Gaz à effet de serre								
CO_2	21%	9%	31%	11%	26%	-	-	-
CH_4	39%	-	10%	18%	7%	-	13%	11%
N_2O	27%	-	9%	15%	20%	-	23%	-
Autres composés organiques cancérogènes								
Benzène	-	-	-	-	**87%**	-	-	-
BaP	-	**50%**	45%	-	-	-	-	-
PCDD/F	-	-	-	**95%**	-	-	-	-
Métaux lourds								
Pb	12%	10%	-	**76%**	-	-	-	-
Cd	40%	-	-	**52%**	-	-	-	-
As	27%	**56%**	10%	7%	-	-	-	-
Ni	**87%**	8%	-	-	-	-	-	-
Hg	8%	-	-	**86%**	-	-	-	-
Cr	34%	9%	10%	31%	15%	-	-	-
Cu	-	-	-	30%	**58%**	9%	-	-
Se	-	**74%**	-	-	20%	-	-	-
V	32%	17%	**51%**	-	-	-	-	-
Zn	15%	7%	-	**59%**	14%	-	-	-

Table 1: Distribution of pollutants emissions in the area of Strasbourg's PPA.

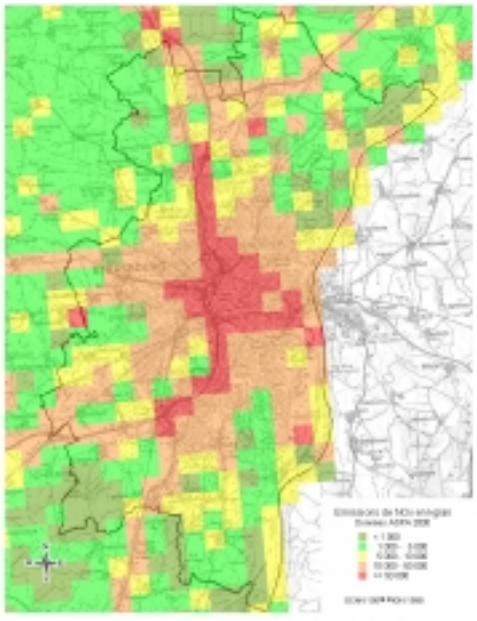
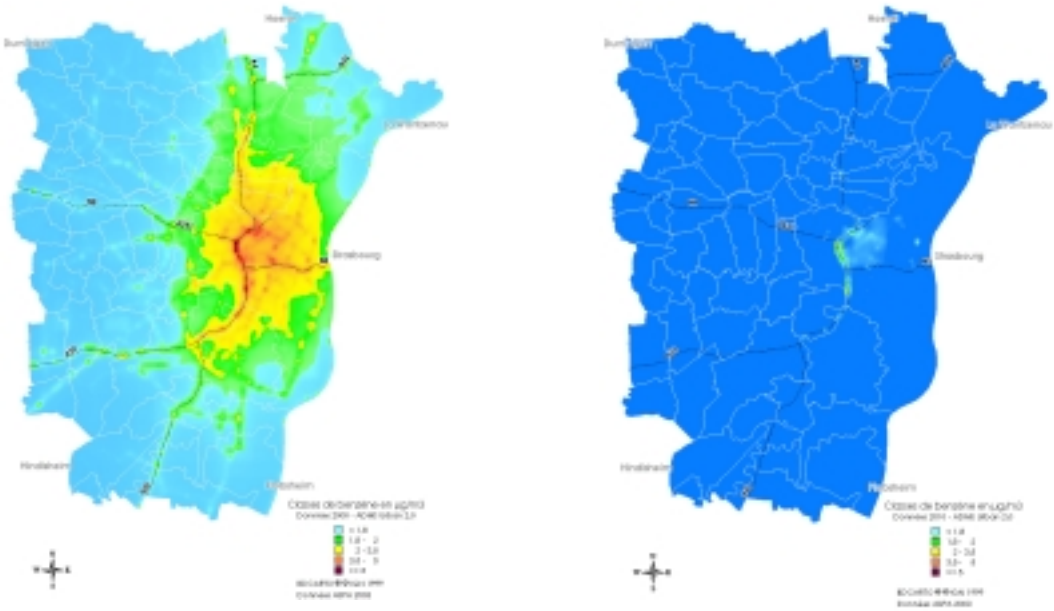


Chart 1: kilometric spatialisation of nitrogen oxides in the area of

Strasbourg's PPA (year 2000).



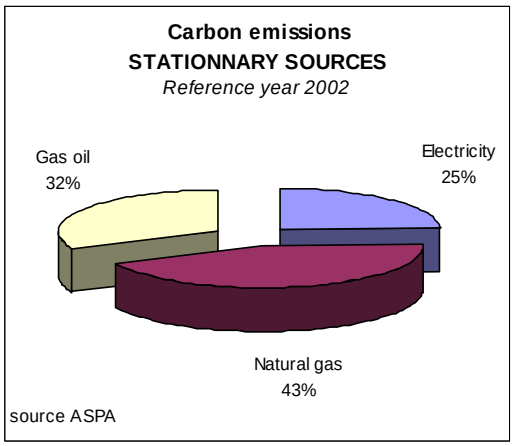
Charts 2 and 3: benzene concentrations in the area of the Strasbourg's PPP (Atmospheric Plan of Protection) in 2000 and 2010 - results issued from simulations carried out using ADMS model.

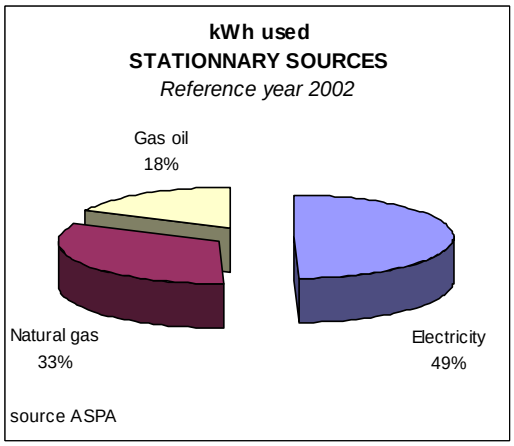
Linked to the road park and fuels (programs Car Oil I and II), but also to industrial NMVOC(Non-Methane Volatile Organic Compounds) emissions evolution (Directive COVNM), benzene concentrations in 2010 should present an important reduction and should not exceed the limit value in application in 2010 (5 µg/m^3 over one year) nor even the French objective of air quality (2 µg/m^3 over one year).

Regional and local management of the greenhouse gases emissions [12] [13]

The General Council of the Bas-Rhin is strongly involved in actions towards sustainable development and sets an example in taking volunteer actions to control greenhouse gases emissions. As a prerequisite it has entrusted ASPA with the execution of a greenhouse gases emissions assessment in order to point out where technical and financial efforts must be raised.

The action of the General Council is covering its own assets and activities (development of a carbon assessment of the entity " GeneralCouncil") as well as its territory of competency (development of an inventory specialised on the emissions in the Bas-Rhin district).





Graphs 7 and 8: Emissions distribution issued from heating and hot water production of the Bas-Rhin General Council buildings.

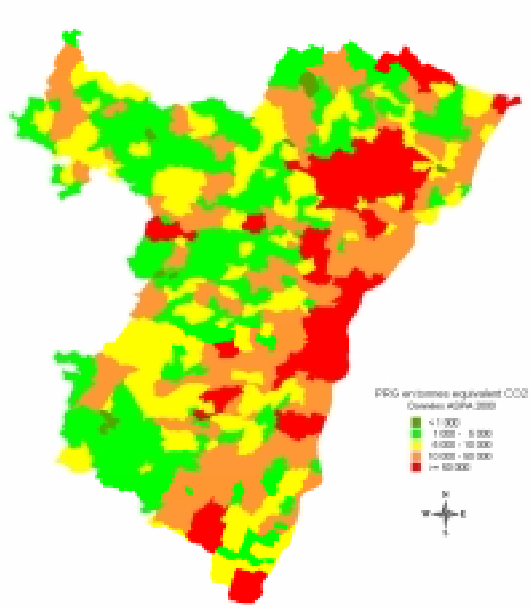


Chart 2: Greenhouse gases emissions of each town of the Bas-Rhin district.

For the patrimonial approach (graphic 7 and 8), results allow to target the important ratio of the greenhouse gases emissions on the energy produced using domestic fuel and the good efficiency of the electricity use.
For the territorial approach (chart 2), results of greenhouse gases emissions per commune allow consciousness raising of at the same time the local councillors and the population.
Indeed they provide the quantitative elements up to the finest spatial levels for emissions reduction measures (installation of solar water heater, exploitation of geothermics in appropriated areas, implementation of wind pumps, …).

CONCLUSION

The regional and local emissions inventories are essential tools to evaluate the impact of reduction measures (whether planned or under discussion)

- Regarding the local phenomena of pollution (industrial or road proximity pollution, urban pollution), the realisation of fine local inventories (on spatial or temporal level) is the only step towards simulating (in space and in time) the levels of air pollution with an acceptable margin of uncertainty.
- Regarding the regional or global pollution phenomena (acidification, photochemistry, greenhouse effect), the regional emissions inventory is complementary to the national or international ones giving opportunity to the local communities decision makers to be involved in the implementation of local emissions reduction actions with the full knowledge of facts.

Headways conducted by the ASPA for Alsace are also progressing in other parts of France. The purpose is to provide national decision makers with methods allowing to cover the whole of the national territory, at restrained costs, with relevant, coherent, comparable and perennial inventories.

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